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# Railway Signal Association

## REVISION OF MANUAL. 1917

### IMPORTANT—READ CAREFULLY

This Index has been prepared for the purpose of rearranging the Manual. Enclosed herewith will be found all subject matter adopted by letter ballot January 10, 1917, this material having been submitted for such action at the 1916 Annual Convention.

Prior to placing this matter in the Manual it should be carefully noted if all previous revisions have been inserted. If not, it is necessary that this be done prior to inserting the Revisions as of 1917. In order to make it clear the following guide is presented:

In the First Issue of the Manual (1912), the Title Page will show,  
"First Edition, 1912."

For 1913 the Title Page will show,

"Second Edition,  
Revised 1913."

For 1914 the Title Page will show,

"Second Edition,  
Revised 1913,  
Revised 1914."

For 1915 the Title Page will show,

"Third Edition,  
Including subject matter approved January 5, 1915."

For 1916 the Title Page will show,

"Third Edition,  
Including subject matter approved January 10, 1916."

For 1917 the Title Page will show,

"Issue of 1917,  
Complete to December 31, 1916."

It will be noted from above that there have been Additions and Revisions prepared every year since 1912, and these should be placed in the Manual in the order in which they were issued.

It must be understood that such portions of existing matter now in the Manual that have not been affected by any revision, or have not become obsolete, are to remain intact; where revisions have been made to any sheet or sheets in existing specifications it will be necessary to substitute such sheet or sheets.

The instructions, as shown on the following pages, are intended as a guide for inserting all new matter, substituting Revisions and removing all obsolete matter, if carefully followed will bring the Manual up to date. In order to differentiate between new, revised and obsolete matter, the following terms are used:

**INSERT.**—New matter not previously shown.

**SUBSTITUTE.**—Existing matter to be removed and revision inserted.

**NO CHANGE.**—Existing matter to be left in its present location.

**OBsolete.**—Matter that has either been incorporated elsewhere or superseded by new matter; such sheets are to be taken out.

# INSTRUCTIONS

## FOR INSERTING SUBJECT MATTER ADOPTED JANUARY, 1917.

(Do not mistake sheets for pages)

Care must be exercised where matter is to be substituted, to be sure that only the sheets affected by the change are removed before the new matter is inserted, as in some cases the original may consist of two or more sheets, whereas the revision may be confined to one sheet, or vice versa.

Existing matter to remain in Manual will be shown in light face type.

New matter and Revisions to existing matter now in Manual will be shown in **black face type**.

New matter and Revisions found in this package to be inserted as follows:

### SPECIFICATIONS.

**Title Page, Issue of 1917—One sheet—Substitute.**

**Preface—One sheet—No change.**

**Contents—Five sheets—Substitute.**

**Subdivision Sheet A-B—One sheet—Substitute.**

**Automatic Block Signal System, A.C. using A.C. for Propulsion.**

**Index—Three sheets—Substitute.**

**Specifications:**

**Pages 1 to 8—Four sheets—Substitute.**

**Pages 9 to 12—Two sheets—No change.**

**Pages 13 to 16—Four sheets—Substitute.**

**Pages 17 to 22—Three sheets—No change.**

**Pages 23 to 28—Four sheets—Substitute.**

**Pages 29 to 36—Four sheets—No change.**

**Automatic Block Signal System, A.C. using D.C. for Propulsion.**

**Index—Four sheets—Substitute.**

**Specifications:**

**Pages 1 to 8—Four sheets—Substitute.**

**Pages 9 to 11—Two sheets—No change.**

**Pages 12 to 15—Four sheets—Substitute.**

**Pages 15½ to 17½—Two sheets—No change.**

**Pages 18 to 24½—Five sheets—Substitute.**

**Pages 25 to 32—Four sheets—No change.**

**Automatic Block Signal System, A.C. Steam Railways, etc.**

**Index—Four sheets—Substitute.**

**Specifications:**

**Pages 1 to 8—Four sheets—Substitute.**

**Pages 9 to 12—Two sheets—No change.**

**Pages 13 to 16—Four sheets—Substitute.**

**Pages 17 to 22—Three sheets—No change.**

**Pages 23 to 25½—Three sheets—Substitute.**

**Pages 26 to 34—Five sheets—No change.**

**Automatic Block Signals Operated by Direct Current.**

**Index—Four sheets—Substitute.**

**Specifications—Twenty-two sheets—Substitute.**

**Battery, Primary—Specifications.**

**Caustic Soda Cells and Renewals—Two sheets—No change.**

**Coppers—One sheet—No change.**

**Zincs—One sheet—No change.**



**Battery, Storage.**

Battery Box, Concrete—Specification—Two sheets—No change.  
 Electrolyte for Lead Type—Specification—One sheet—No change.  
 Charging Cells—Instructions—One sheet—No change.  
 Operation at Interlocking Plants—Instructions—Two sheets—No change.  
 Operation in Block Signal Service—Instructions—Two sheets—No change.  
 Nicket, Iron, Alkaline—Specification—Two sheets—No change.  
 Installation of Lead Covered—Directions—One sheet—No change.  
 Operation of Lead Type Portable—Instructions—Two sheets—No change.

**Lead Type Portable (including drawing 1248)—Specification—Six sheets—Substitute.**

**Composite Type Stationary—Specification—Three sheets—Insert.**

Lead Type Stationary—Specification—Two sheets—No change.

Lead Type Stationary (Not of the pure lead type)—Specification—One sheet—No change.

Installation of Lead Type—Directions—Two sheets—No change.

Bells, Annunciator—Specification—One sheet—No change.

Bells, D.C. Vibrating—Specification—Two sheets—No change.

**Bridges, Movable, Protection of—Requirements—Three sheets—Insert.**

**Subdivision Sheet C-E—One sheet—Substitute.**

**Cables—Specifications:**

**Aerial Aluminum—Three sheets—Insert.**

Aerial Braided, 660 Volts—Four sheets—No change.

Armored Submarine, 660 Volts—Five sheets—No change.

Armored Submarine, 2200 Volts—Five sheets—No change.

Lead Covered, 660 Volts—Four sheets—No change.

Lead Covered, 2200 Volts—Four sheets—No change.

Underground Braided, 660 Volts—Four sheets—No change.

Channel Pins—Specification—Two sheets—No change.

Circuit Nomenclature—Six sheets—No change.

Clearance Diagram—One sheet—No change.

Concrete—Specification—Two sheets—No change.

**Conduit—Specifications:**

Fibre—Two sheets—No change.

Pipe, Steel—Two sheets—No change.

Pipe, Wrought Iron—Two sheets—No change.

**Fibre and Metal Systems—Installation—Four sheets—Insert.**

Vitrified Clay—Two sheets—No change.

Vitrified Clay System—Installation—Three sheets—No change.

Copper Sulphate—Specification—One sheet—No change.

Crossarms, Wood—Specification—Two sheets—No change.

Crossarm Braces, etc.—Specification—One sheet—No change.

Crossarm Pins—Specification—Two sheets—No change.

Crossarm Through Bolts, etc.—Specification—One sheet—No change.

Definitions for Technical Terms—Two sheets—No change.

**Drawbridge, Protection for Elec. Pneu. Intkg.—One sheet—Obsolete.**

**Drawbridges, Recommendation for Interlocking—Two sheets—Obsolete.**

Designs, Standard Drawings—See separate list. It is recommended that drawings be placed in a separate volume, in numerical order.

Engine, Gasoline, etc.—Specification—One sheet—No change.



**Subdivision Sheet F-L—One sheet—Substitute.**

Fibre, Hard—Specification—One sheet—No change.

Forms for Recording Signal Performance—Five sheets—No change.

Fuses—Specification—Two sheets—No change.

Galvanizing for Iron or Steel—Specification—Two sheets—No change.

**General Provisions, Signal Installations—Specification—Seven sheets—Insert.**

Generator, Electric—Specification—One sheet—No change.

Generator, Electric, A.C.—Specification—Four sheets—No change.

Impedance Bonds, A.C. Pro.—Specification—One sheet—No change.

Impedance Bonds, D.C. Pro.—Specification—One sheet—No change.

Impregnation Treatment, Coils and Windings—Specification—Two sheets—No change.

**Indications, Principles of Signal—One sheet—Insert.**

Indicator, Take Siding (two cuts)—Instructions—Three sheets—No change.

**Indicators, Switch—Requisites—Two sheets—Substitute.**

Instructions for Testing and Maintaining Dry Cells—One sheet—No change.

Instructions for Maintenance of Gravity Cells—Two sheets—No change.

Instructions for Maintenance of Caustic Soda Cells—Two sheets—No change.

Interlocking, Electric.

**Index—Four sheets—Substitute.**

Specifications:

Pages 1 to 8—Three sheets—Substitute.

Pages 9 to 14—Three sheets—No change.

Pages 15 and 16—Two sheets—Substitute.

Pages 17 to 20—Two sheets—No change.

Pages 21 and 22—Two sheets—Substitute.

Pages 23 to 32—Five sheets—No change.

Page 33—One sheet—Substitute.

Interlocking, Electro-Mechanical.

**Index—Six sheets—Insert.**

Specifications—Thirty-seven sheets—Insert.

Interlocking, Electro-Pneumatic.

**Index—Four sheets—Substitute.**

Specifications:

Pages 1 to 10—Five sheets—Substitute.

Pages 11 to 16—Three sheets—No change.

Pages 17 and 18—Two sheets—Substitute.

Pages 19 to 22—Two sheets—No change.

Pages 23 to 26—Four sheets—Substitute.

Pages 27 to 34—Four sheets—No change.

Pages 35 and 36—Two sheets—Substitute.

Interlocking, Mechanical.

**Index—Three sheets—Substitute.**

Specifications—Nineteen sheets—Substitute.

Iron, Gray Castings—Specification—One sheet—No change.

Iron, Malleable Castings—Specification—One sheet—No change.

Iron, Wrought Bars—Specification—One sheet—No change.

Lamps, Incandescent Electric—Four sheets—No change.



**Lightning Protection:**

Arresters—Requisites—One sheet—No change.

Choke Coils—Requisites—One sheet—No change.

Vacuum Gap Arresters—Specification—Two sheets—No change.

**Subdivision Sheet M-S—One sheet—Substitute.**

Oil, Illuminating—Specification—One sheet—No change.

Oil, Transformers—Specification—One sheet—No change.

Petroleum for use in Imp. Bonds—Specification—One sheet—No change.

Petroleum Asphaltum—Specification—One sheet—No change.

Pipe, Soft Steel—Specification—One sheet—No change.

Pipe, Wrought Iron—Specification—One sheet—No change.

Poles, White Cedar—Specification—Two sheets—No change.

Push Buttons—Specification—One sheet—No change.

Pushes, Floor—Specification—One sheet—No change.

Reactors—Specification—Two sheets—No change.

**Relays, A.C.—Specification—Six sheets—Insert.**

Relays, D.C. Neutral Type—Specification—Three sheets—No change.

Releases, Mech. and Elec.—Specification—One sheet—No change.

Roundels, Lenses and Slides—Specification—Two sheets—No change.

Rules Governing Maintenance of Block Signals—One sheet—No change.

Rules Governing Signal Foremen—One sheet—No change.

Rules Governing Signal Maintainers—Two sheets—No change.

Rules Governing Signal Supervisors—One sheet—No change.

Signal Motors, D.C.—Specification—Four sheets—No change.

**Signal Indications, Principles of—One sheet—Obsolete.**

Signaling Practice—Essentials—Two sheets—No change.

Steel, Machinery—Specification—One sheet—No change.

Switchboards—Specification—One sheet—No change.

Switchboards and Equipment, A.C. System—Specification—Five sheets—No change.

**Subdivision Sheet T-Z—One sheet—Substitute.**

Tape, Friction—Specification—Two sheets—Substitute.

Tape, Rubber Insulating—Specification—Pages 1 and 2—Two sheets—Substitute.

Terminology, Electric Wire and Cable—Two sheets—Insert.

Train Control, Automatic—Requisites—One sheet—No change.

Transformers, Line, 4400 Volts—Specification—Six sheets—Substitute.

Transformers, Track, 250 Volts—Specification—Four sheets—No change.

Trunking, Grooved, and Capping—Specification—Three sheets—Substitute.

Voltage Ranges for Signal Work—One sheet—No change.

Wires, Copper Clad Steel Bonding—Specification—One sheet—No change.

Wires, E. B. B. Bonding—Specification—Two sheets—No change.

Wire, Line, Copper Clad Steel—Specification—One sheet—No change.

Wire, Line, W. P. D. B. Galvanized B. B.—Specification—Two sheets—No change.



Wire, Line, W. P. D. B. Copper—Specification—Two sheets—No change.  
 Wire, Magnet, Cop. Enam.—Specification—Two sheets—No change.  
 Wire, Messenger, Galv.—Specification—One sheet—No change.  
 Wire, Messenger, Sags for—Table—One sheet—No change.  
 Wire, Rubber Insulated—Specification—Four sheets—No change.  
 Wire, Galvanized Steel—Specification—Two sheets—No change.  
 Wire, Insulation Resistance—Table—One sheet—No change.  
 Wire, Stranded and Flexible Condr's—Table—One sheet—No change.  
 Wire, Insulating Machine—Type—One sheet—No change.  
 Wire Inspection Report—One sheet—No change.  
 Wire Crossings Over Other Lines—Specifications—Six sheets—No change.



# Designs--Standard Drawings

## INSTRUCTIONS

### FOR INSERTING SUBJECT MATTER ADOPTED JANUARY, 1917

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The following arrangement is for placing the drawings in numerical order.

**Title Page**—One sheet—Substitute.

**Index**—Alphabetical—Ten sheets—Substitute.

**Index**—Numerical—Seven sheets—Substitute.

#### DRAWINGS AS FOLLOWS:

1001, 1002, 1007, 1008, 1009, 1010, 1011, 1013, 1014 and 1015—Ten sheets—No change.

**1016 and 1017**—Two sheets—Substitute.

1018—One sheet—No change.

**1019**—One sheet—Substitute.

1020, 1021, 1022, 1023, 1024, 1025, 1026, 1027, 1028, 1029, 1030, 1031, 1032, 1033, 1034, 1035, 1036, 1038, 1039, 1040, 1041, 1043, 1044, 1045, 1049, 1050, 1052, 1053 and 1055—Twenty-nine sheets—No change.

**1056**—One sheet—Substitute.

1057, 1058, 1059, 1060, 1061, 1062, 1063, 1064, 1065, 1066, 1067, 1068, 1069, 1070, 1071 and 1072—Sixteen sheets—No change.

**1073**—One sheet—Substitute.

1080—One sheet—No change.

**1082**—One sheet—Substitute.

1083, 1084, 1085, 1086, 1087, 1088, 1089, 1090, 1091, 1092 and 1093—Eleven sheets—No change.

**1094**—One sheet—Substitute.

1095, 1096, 1097, 1098, 1099, 1100, 1101 and 1102—Eight sheets—No change.

**1103**—One sheet—Substitute.

1104—One sheet—No change.

**1105**—One sheet—Substitute.

1106—One sheet—No change.

**1107 and 1108**—Two sheets—Substitute.

1109, 1154, 1155, 1156, 1157, 1165, 1166, 1167 and 1173—Nine sheets—No change.

**1174**—One sheet—Substitute.

**1175**—One sheet—Insert.

1176, 1177, 1178, 1179, 1180, 1181, 1182, 1185, 1189, 1190 and 1191—Eleven sheets—No change.



**1191—One sheet—Substitute.**

1195, 1196, 1197, 1198, 1199, 1200, 1201, 1202, 1203, 1204, 1205, 1206, 1207, 1217, 1219, 1220, 1223, 1224 and 1225—Nineteen sheets—No change.

**1226 and 1227—Two sheets—Substitute.**

1228, 1229, 1230, 1231, 1232 and 1233—Six sheets—No change.

**1235—One sheet—Insert.**

**1236—One sheet—Substitute.**

1237, 1238, 1239, 1240, 1241, 1242, 1243, 1244, 1246 and 1247—Ten sheets—No change.

**1259—One sheet—Insert.**

1309, 1329, 1331, 1332, 1333, 1334, 1335, 1336, 1337, 1338, 1339, 1340, 1341 and 1342—Fourteen sheets—No change.

**1343—One sheet—Substitute.**

1344, 1345, 1350, 1351 and 1352—Five sheets—No change.

**1355, 1356 and 1357—Three sheets—Insert.**

1360 and 1361—Two sheets—No change.

**1379 and 1387—Two sheets—Insert.**

1388 and 1389—Two sheets—No change.

**1390, 1391, 1392 and 1393—Four sheets—Insert.**

1397—One sheet—No change.

**1399, 1400, 1402 and 1420—Four sheets—Insert.**

Symbols—Twelve sheets—No change.



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# THE MANUAL

OF THE

# RAILWAY SIGNAL ASSOCIATION

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## SPECIFICATIONS

ISSUE OF 1917

Complete to December 31, 1916

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Compiled for the Board of Direction by the Editing Committee consisting of

H. S. Balliet, Chairman  
W. J. Eck, F. P. Patenall,  
C. C. Rosenberg

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Published by the Association  
BETHLEHEM, PA.

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# SPECIFICATIONS

## CONTENTS\*

1916

ANNUNCIATORS.—See Bells.

AUTOMATIC BLOCK SIGNALS.

- Alternating Current—A.C. Propulsion, Specifications.
- Alternating Current—D.C. Propulsion, Specifications.
- Alternating Current—Steam Railways, Specifications.
- Direct Current—Specifications.

AUTOMATIC TRAIN CONTROL.

- Requisites of Installation and Adjuncts. (The Am. Ry. Assn.)

BATTERY, PRIMARY.

- Caustic Soda Primary Cell—Specification.
- Coppers—Gravity Battery, Specification.
- Copper Sulphate, Crystallized, Specification.
- Jar.—See Drawing 1189.
- Zinc—Gravity Battery, Specification.

BATTERY, STORAGE.

- Concrete Box, Specification.
- Lead Type, Electrolyte for, Specification.
- Lead Type, Instructions for Operation.
- Lead Type, Instructions for Interlockings.
- Lead Type, Instructions for Block Signal Service.
- Nickel, Iron, Alkaline, Specification.
- Portable Lead Type, Directions for Installation.
- Portable Lead Type, Instructions for Operation.
- Portable Lead Type, Specifications.
- Stationary Composite Type, Specification.
- Stationary Pure Lead Type, for Signaling, Specification.
- Stationary—Not of the Pure Lead Type, Specification.
- Stationary Lead Type, Directions for Installation.

BELLS.

- Annunciator, Specification.
- Highway Crossing, D.C. Vibrating, Specification.

BRIDGES, MOVABLE, Protection of Traffic at.

BUTTONS.—See Push Buttons.

CABLES.

- Aerial Aluminum, Specification.
- Aerial Braided, for 660 Volts or less, Specification.
- Armored Submarine, for 660 Volts or less, Specification.
- Armored Submarine, for 2200 Volts, Specification.
- Lead Covered, for 660 Volts or less, Specification.
- Lead Covered, for 2200 Volts, Specification.
- Underground Braided, for 660 Volts, Specification.

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\*Where additions or revisions have been made, the changes are designated at the end of section or paragraph by inserting date on which the change was made. The date appearing underneath the title is the year in which the subject was first adopted or revised.

# SPECIFICATIONS

## 1. GENERAL

1.1

1.2

1.3

1.4

1.5

1.6

1.7

1.8

1.9

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1.11

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1.21

1.22

1.23

1.24

1.25

1.26

1.27

1.28

1.29



CELL.—See Battery, Primary.

CHANNEL PINS.—Specification.

CIRCUIT NOMENCLATURE AND WRITTEN CIRCUITS.

CLEARANCE DIAGRAM. (The Am. Ry. Assn.)

COILS AND WINDINGS—For Impregnation Treatment, Specifications.

CONCRETE.

Box—See under Battery, Storage.

Portland Cement, Specification.

CONDUIT.

Fibre, Specification.

Pipe, Steel, Specification.

Pipe, Wrought Iron, Specification.

Fibre and Metal, Installation of a System, Specification.

Vitrified Clay, Specification.

Vitrified Clay, Installation of a System, Specification.

COPPER SULPHATE.—See Battery, Primary.

COPPERS.—See Battery, Primary.

CROSS-ARMS.

Wood, Specification.

Braces and Heel and Toe Bolts for, Specification.

Steel Pins for, Specification.

Through Bolts and Double-arm Bolts for, Specification.

DEFINITIONS FOR TECHNICAL TERMS.

DRAWINGS.—See Standard Designs. (Separate Section.)

ENGINE, GASOLINE, WITH FUEL AND WATER TANKS—Specification.

FIBRE, HARD—Specification.

FLOOR PUSHES.—See Pushes, Floor.

FORMS.—See Performance of Recording, Signal.

FRICTION TAPE.—See Tape.

FUSES—Specification.

GALVANIZING FOR IRON OR STEEL—Specification. (Am. Ry. Assn.)

GASOLINE ENGINE.—See Engine.

GENERAL PROVISIONS OF SIGNAL INSTALLATIONS—Specification.

GENERATORS.

A.C. Electric, Specification.

D.C. Electric, Specification.

GLASS, SIGNAL.—See Roundels.

GRAY IRON CASTINGS.—See Iron.

HIGHWAY CROSSING ALARMS.—See Bells.

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January 10, 1900.

TO THE HONORABLE THE SENATE,  
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YOUR COMMISSIONER HAS THE HONOR TO

REPORT TO YOU THE RESULTS OF HIS

ADMINISTRATION DURING THE YEAR

ENDING DECEMBER 31, 1899.

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ENDING DECEMBER 31, 1899.

YOUR COMMISSIONER HAS THE HONOR



IMPEDANCE BONDS.

- 11,000 Volts, A.C. Propulsion, Specification.
- D.C. Propulsion Specification.
- Petrolatum for Use in, Specification.

IMPREGNATION TREATMENT OF COILS AND WINDINGS—Specification.

INDICATIONS, SIGNAL, Principles of.

INDICATORS.—See Switch Indicators, or Take Siding Indicator.

INSTRUCTIONS.

- Testing and Maintaining Dry Cells.
- Maintenance of Gravity Cells.
- Maintenance of Caustic Soda Cells.

INTERLOCKING.

- Electric, Specifications.
- Electro-mechanical, Specifications.
- Electro-pneumatic, Specifications.
- Mechanical, Specifications.

IRON.

- Castings, Gray, Specification.
- Malleable, Specification.
- Wrought Bars, Specification.

LAMPS—Incandescent Electric, Specification.

LENSES.—See Roundels.

LIGHTNING PROTECTION.

- Arresters, Requisites for.
- Choke Coils, Requisites for.
- Vacuum Gap, Specification.

MACHINERY STEER.—See Steel, Machinery.

MOVABLE BRIDGES, Protection.—See Bridges.

OIL.

- Illuminating, Specification.
- Transformer, Specification.

PERFORMANCE, SIGNAL—Forms for Recording.

PETROLEUM ASPHALTUM—Specification.

PINS.—See Channel Pins, or Cross-arms—Steel Pins.

PIPE, SIGNAL.

- Soft Steel, One-Inch, Specification.
- Wrought Iron, One-Inch, Specification.

POLES, EASTERN WHITE CEDAR—Specification.

PROTECTION OF TRAFFIC AT MOVABLE BRIDGES.—See Bridges.

PUSH BUTTONS—Specification.

PUSHES, FLOOR—Specification.

REACTORS FOR LINE AND TRACK CIRCUITS—Specification.

RELAYS, ALTERNATING CURRENT—Specification.

RELAYS, LIFTING ARMATURE, NEUTRAL TYPE, D.C.—Specification.

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*Railway Signal Association.*

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RELEASES, MECHANICAL AND ELECTRIC—Specification..

ROUNDELS, LENSES AND SLIDES—Specification.

RUBBER INSULATING TAPE.—See Tape.

RULES.

Governing Maintenance of Block Signals.

Governing Signal Foremen.

Governing Signal Maintainers.

Governing Signal Supervisors.

SIGNALS, D.C. MOTOR SEMAPHORE—Specification.

SIGNAL INSTALLATIONS, GENERAL PROVISIONS OF—Specifications.

SIGNAL PERFORMANCE.—See Performance, Signals, Forms for Recording.

SIGNALING PRACTICE.

Signal Indications and Aspects. (Am. Ry. Eng. Assn.)

Signal Indications, Principles of.

STANDARD DESIGNS.—See Separate Section.

STEEL, MACHINERY—Specification.

STEEL PIPE.—See Pipe.

SULPHATE.—See Copper Sulphate.

SWITCHBOARDS.

Slate, for Battery Charging, Specification.

Slate and Equipment for A.C. Signal System, Specification.

SWITCH INDICATORS, PURPOSES AND REQUISITES OF INSTALLATION.

TAKE SIDING INDICATOR.

TERMINOLOGY, ELECTRIC WIRE AND CABLE.

TRAIN CONTROL.—See Automatic Train Control.

TRANSFORMERS.

Single-phase Line, Oil Immersed, Self-Cooled, Outdoor Type, 4400 Volts or less, Specification.

Single-phase Track, 250 Volts or less, Specification.

TRUNKING, WOOD—Specification.

VOLTAGE RANGES FOR SIGNAL WORK.

WIRE.

Bonding—Copper-clad Steel, Specification.

Bonding—Galvanized E. B. B., Specification.

Line—Copper-clad Steel, Specification.

Line—W. P. D. B., B. B., Specification.

Line—W. P. D. B., Copper, Specification

Magnet—Copper Enameled, Specification.

Messenger—Galvanized, Specification.

Messenger—Recommended Sags for.

Rubber Insulated—Copper, Specification.

Rubber Insulated—Inspection Report, Form for.

Rubber Insulated—Insulation Resistances.

Ruber Insulated—Machine for Insulating, Type of.

Steel—Signal Galvanized, Specification.

Stranded and Flexible Conductors, Table of.

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5  
*Railway Signal Association.*

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Crossings of Wires or Cables of Telegraph, Telephone, Signal and other Circuits of Similar Character over Steam Railroad Rights of Way, Track or Lines of Wires of the same classes, Specifications. (Am. of Ry. Teleg. Supts.)

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WROUGHT IRON BARS.—See Iron.

WROUGHT IRON PIPE.—See Pipe.

ZINCS.—See Battery, Primary.

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*Zinc, Gravity Battery, Specification.*

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*Concrete Box, Specification.*

*Lead Type, Electrolyte for, Specification.*

*Lead Type, Instructions for Operation.*

*Lead Type, Instructions for Interlockings.*

*Lead Type, Instructions for Block Signal Service.*

*Nickel, Iron, Alkaline, Specification.*

*Portable Lead Type, Directions for Installation.*

*Portable Lead Type, Instructions for Operation.*

*Portable Lead Type, Specification.*

*Stationary Composite Type, Specification.*

*Stationary Pure Lead Type, for Signaling, Specification.*

*Stationary—not of the Pure Lead Type.*

*Stationary Lead Type, Directions for Installation.*

**BELLS.**

*Annunciator, Specification.*

*Highway Crossing, D.C. Vibrating, Specification.*

**BRIDGES.**

*Protection of—Requirements.*



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Automatic Control of Current Specifications

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Automatic Control of Installation and Adjustments

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SYNCHRONIC TRACK STORAGE

Lead Type Electrolyte for Specification

Lead Type Electrolyte for Specification

Lead Type Electrolyte for Specification

Lead Type Electrolyte for Specification

Lead Type Electrolyte for Specification

Lead Type Electrolyte for Specification

Lead Type Electrolyte for Specification

Lead Type Electrolyte for Specification

Lead Type Electrolyte for Specification

Stationary Pure Lead Type for Signaling Specification

Stationary--not of the Pure Lead Type

Stationary Lead Type, Directions for Installation

BELL

Automatic Control of Installation and Adjustments

SYNCHRONIC TRACK STORAGE

Protection of--Requirements

# SPECIFICATIONS AND REQUISITES OF APPARATUS AND MATERIAL FOR ALTERNATING CURRENT AUTO- MATIC BLOCK SIGNAL SYSTEM.

(On railways using alternating current for propulsion.)

1913.

Revised 1916.

To be installed at.....  
on the ..... R .....

## INDEX.

Section.

Air Compressor .....	63
Air pipe line .....	98
Arresters, lightning .....	635
boxes .....	722
Bolts, signal foundation.....	271
Bonding .....	540 to 550
wires .....	540
Bootlegs .....	708
Boxes, junction .....	710
cable .....	718
lightning arrester .....	722
relay .....	720
Buildings .....	50 to 60
foundations .....	50
painting .....	840
Cable boxes .....	718
Cables for high voltage circuits.....	524
for low voltage circuits.....	522
Channel pins .....	542
Circuits .....	500 to 520
electric lighting .....	506
practice .....	500
special .....	510
track .....	502
switchboard .....	501
Common return .....	526
Compressor, air .....	63
Concrete .....	280
Condensers .....	95
Conduits and supports.....	711
Control apparatus .....	610 to 650
Controllers, circuit .....	610
Detail provisions .....	50 to 950
Distributing system .....	98 to 100
Electric lighting circuits .....	506
locks .....	615
Electrical requirements .....	30





2  
*Railway Signal Association.*

A.C. Automatic  
Block Signals.  
A.C. Propulsion.  
Index to  
Specifications.

	Section.
Engine .....	61
Fibre, insulating .....	748
Foundation bolts, signal .....	271
Foundations .....	270
building .....	50
Fuses .....	528
General provisions.—See unit specifications.	
Generator .....	65
Impedance bonds .....	543
Impedance coils .....	544
Indicators .....	625
Instrument shelter .....	720 to 735
Insulated rail joints .....	735
Insulating fibre .....	748
Insulations .....	735 to 800
pipe line .....	742
switch rod .....	738
tie plate .....	744
Iron work, painting .....	810
Joints in wire .....	527
rail, insulated .....	735
trunking .....	703
Junction boxes .....	710
terminals .....	928
Lamps .....	430
Lamp boxes .....	431
Lighting .....	54
Lightning arrester boxes .....	722
arresters .....	635
Line construction .....	714
Line supports .....	715
Locations, signal .....	435
Locks .....	925
electric .....	615
time .....	622
Main supply .....	76
auxiliary supply .....	77
Motor .....	70
Motor generator .....	75
Number plates and numbers .....	926
Painting .....	800 to 900
buildings .....	840
Paint .....	800
iron work .....	810
wood work .....	830

288	.....	.....
289	.....	.....
290	.....	.....
291	.....	.....
292	.....	.....
293	.....	.....
294	.....	.....
295	.....	.....
296	.....	.....
297	.....	.....
298	.....	.....
299	.....	.....
300	.....	.....
301	.....	.....
302	.....	.....
303	.....	.....
304	.....	.....
305	.....	.....
306	.....	.....
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487	.....	.....
488	.....	.....
489	.....	.....
490	.....	.....
491	.....	.....
492	.....	.....
493	.....	.....
494	.....	.....
495	.....	.....
496	.....	.....
497	.....	.....
498	.....	.....
499	.....	.....
500	.....	.....

	Section.
Petroleum asphaltum .....	532
Pins, channel .....	542
Pipe line insulation .....	742
Plant .....	60
Power house .....	52
Rail joints, insulated .....	735
Relay boxes .....	720
cases .....	721
Releases, hand .....	618
Roundels .....	425
Shelter, grid or unit .....	724
transformer .....	723
Signal locations .....	435
Signals, type and assembly .....	400
electric motor type .....	440
electro-pneumatic type .....	442
light type .....	443
solenoid type .....	441
Special circuits .....	510
items .....	900 to 950
Supports, high voltage cable .....	717
line supports .....	715
trunking .....	705
Switchboards and equipment .....	90
circuits .....	501
Switch indicators .....	625
rod insulations .....	738
Tags .....	530
Tie plate insulations .....	744
Track circuits .....	502
Transformers .....	80
shelter .....	723
Trunking .....	700 to 710
supports .....	705
joints .....	703
Type and assembly of signals .....	400
Wire and wiring .....	520 to 540
bonding .....	540
joints .....	527
line for high voltage circuit .....	523
sizes .....	521
specifications .....	520
Wiring .....	525
Wood work, painting .....	830





SPECIFICATIONS AND REQUISITES OF APPARATUS AND  
MATERIAL FOR ALTERNATING CURRENT AUTO-  
MATIC BLOCK SIGNAL SYSTEM.

(On railways using alternating current for propulsion.)

1913

Revised 1916.

GENERAL PROVISIONS OF SPECIFICATIONS FOR  
SIGNAL INSTALLATIONS.

(See unit specification covering the text of these provisions indexed  
under Subdivision G.)

*Note.*—This unit specification has been adopted as of January 10, 1917, to take the place of the "General Provisions," heretofore forming a part of these specifications. This sheet is numbered 1 to 5, in order to obviate the necessity of having the existing subject matter reprinted.





## GENERAL ELECTRICAL REQUIREMENTS.

### 30 20. General electric requirements.

(a) Electric apparatus shall withstand an insulation test at the place of manufacture of three thousand (3000) volts a.c. for one (1) minute. 1911.

(b) Magnets and solenoids shall be plainly marked with their resistance and the size of wire with which they are wound. 1911.

(c) Windings shall be treated in accordance with R. S. A. specifications for "Impregnation Treatment for Coils and Windings." 1916.

## DETAIL PROVISIONS.

### BUILDINGS

#### 50. Foundations.

(a) Foundations shall be provided by the ..... in accordance with specifications and drawings ....., dated ..... 1916.

(b) The foundation for interlocking station leadout supports shall be furnished in place by the ..... in accordance with R. S. A. drawings 1200, 1203, or 1217. 1916.

#### 52. Power house.

Building shall be provided by the ..... in accordance with specifications and drawings ....., dated ..... 1916.

#### 54. Lighting.

(a) The lighting for buildings shall be installed by ..... 1911.

(b) The type of fixtures, numbers, kind, size and switch control of electric lamps shall be in accordance with .... specifications and drawing ....., dated .....; lamps distributed as follows:

	Number.	Watts per Lamp.
Operating room	..... (..)	..... (..)
Tower room	..... (..)	..... (..)
Battery room	..... (..)	..... (..)
Generator room	..... (..)	..... (..)
Special	..... (..)	..... (..)

1916.

# GENERAL ELECTRICAL REQUIREMENTS

General electric requirements

- (a) Electric apparatus shall withstand an insulation test at the place of manufacture of three thousand (3000) volts a.c. for one (1) minute.
- (b) Motors and generators shall be tested with their resistance and the speed of rotation with which they are wound.
- (c) Windings shall be tested in accordance with R. S. A. specifications for "Impregnation Treatment for Coils and Windings".

## DETAIL PROVISIONS

### BUILDINGS

- (a) Foundations shall be provided by the building in accordance with specifications and drawings.
- (b) The foundation for anchoring station lead-in supports shall be furnished in place by the building in accordance with R. S. A. drawings 1200, 1203, or 1217.

Building shall be provided by the building in accordance with specifications and drawings.

- (a) The lighting for buildings shall be installed by the building in accordance with specifications and drawings.
- (b) The type of fixtures, numbers, kind, size and switch control of electric lamps shall be in accordance with specifications and drawings.

Watts per lamp

Number

Watts per lamp	Number	Generator room	Special
( )	( )	( )	( )
( )	( )	( )	( )
( )	( )	( )	( )

54. *Lighting*.—Continued.

(c) Fixtures for electric lighting shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

(d) Fixtures and accessories for electric lamps shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

POWER SUPPLY

60. *Plant*.\*

(a) The power plant shall consist of .....  
 ..... 1916.

(b) .....  
 shall be furnished by ..... and installed  
 by ..... 1916.

(c) .....  
 shall be furnished by ..... and installed  
 by ..... 1916.

61. *Engine*.

(a) A ..... (..) cylinder ..... (..)  
 cycle { vertical } { steam } engine of ..... (..)  
       { horizontal } { air }  
       { turbine }  
 brake horse-power, manufactured by ....., in-  
 stalled by ....., the ..... shall be fur-  
 nished on a ..... foundation, to be furnished in  
 place by the ....., constructed in accordance  
 with the standard specifications of the ..... and  
 drawings of the Manufacturer of the engine numbers  
 ....., dated ..... 1916.

(b) Gasoline engines, fuel and water tanks shall conform to R. S. A. specifications. 1916.

(c) Engines shall be of such type as to be easily accessible for attention to bearings, adjusting and cleaning. 1916.

(d) Contractor shall furnish sufficient material for installation of muffler outside of building with as few turns and bends as practicable. 1916.

(e) A complete set of wrenches shall be furnished. 1911.

---

\*R. S. A. drawings 1388 and 1389 may be used as guides in determining the parts of each plant, which may then be specified in Section 60.



Lighting—Continued.

- (c) Fixtures for electric lighting shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities.
- (d) Fixtures and accessories for electric lighting shall be in accordance with the rules of the National Board of Fire Underwriters.

- (a) The power plant shall consist of

- (b) shall be furnished by
- (c) shall be furnished by

- (a) A ( ) cylinder ( ) engine of ( ) cycle ( ) horizontal ( ) vertical

brake horse-power, manufactured by ( ) shall be furnished on a foundation, to be furnished in place by the ( ) constructed in accordance with the standard specifications of the ( ) and drawings of the Manufacturer of the engine numbers

- (b) Gasoline engines fuel and water tanks shall conform to R. S. A. specifications.

- (c) Engines shall be of such type as to be easily accessible for attention to bearings, adjustment and cleaning.

station or meter outside of building with as few turns and bends as practicable.

- (a) A complete set of wrenches shall be furnished.

\* R. S. A. drawings 1988 and 1989 may be used as guides in determining the parts of each plant, which may then be specified in Section 20.

61. *Engine.*—Continued.

(f) Exposed piping subject to excessive heat shall be  
protected with  $\left\{ \begin{array}{l} \text{asbestos} \\ \text{.....} \end{array} \right\}$  covering. 1916.

63. *Air compressor.*

A  $\left\{ \begin{array}{l} \text{one} \\ \text{two} \end{array} \right\}$  stage air compressor of ..... (..)  
indicated horsepower, capacity of ..... (..) cubic  
feet of free air per minute at ..... (..) feet  
elevation above sea level, and designed for air pressure  
of ..... (..) pounds, manufactured by .....  
....., installed by the ..... shall be fur-  
nished on a ..... foundation, to be furnished in  
place by the ..... constructed in accordance  
with the standard specifications of the .....  
and drawings of the Manufacturer. 1911.

65. *Generator.*

The electric generator shall be in accordance with  
R. S. A. specifications. 1916.

70. *Motor.*

The motor shall be ..... (..) horsepower,  
with a rated speed not to exceed ..... (..) r. p. m. if direct current, or one thousand eight hundred  
(1800) r. p. m., if alternating current, and shall have auto-  
matic regulation to within twenty (20) per cent., when  
operating on ..... (..) to ..... (..) volts d.c., or on ..... (..) to ..... (..) volts ..... (..) cycles ..... (..) phase a.c., shall be in accordance with R. S. A.  
specifications for "Electric Generators" regarding heat-  
ing, sparking and insulation, and shall be furnished with  
a starting panel. 1916.

75. *Motor generator.*

Motor generators shall be direct connected, mounted  
on a cast iron sub-base and shall conform to the specifica-  
tions for motors and generators (Sections 65 and 70). 1911.





98. *Air pipe line.*—Continued.

(m) Each branch line must contain a combined brass cock and union at or near its connection with the main.

1911.

(n) The main air line must be in good surface and auxiliary tanks connected in line at the bottom of all slopes, and the air line shall be graded, so condensation will run into suitable drain tanks. Auxiliary tanks shall be connected in series with the main air line and be provided with by-pass of the same size as the main air line. Flanges, unions, gate valves, etc., shall be provided so that auxiliary tanks may be removed without interrupting the flow of air through the by-pass.

1915.

(o) The air line when placed above ground parallel to the track shall not be placed nearer than six (6) feet from the gauge side of nearest rail except by special permission.

1911.

(p) Local conditions shall determine the height of the main air line when above ground, but in all cases, the bottom of the pipe shall be not less than six (6) inches above the top of the ground, except by special permission.

1915.

(q) Stakes for supports shall be placed not more than ten (10) feet apart.

1911.

(r) Red lead, graphite or other equivalent protections for threads must be applied to the pipe threads and only after pipe connections have been started when pipe is coupled.

1915.

(s) Each length of pipe and the fittings must be free from dirt and scale before being coupled in the line, and care must be exercised that no dirt gets into the line at any time. All pipe lines must be blown out before being connected to any apparatus.

1911.

## FOUNDATIONS

270. *Foundations.**Field work.*

(a) Foundations shall be rigid, level, and in good alignment.

1916.

(b) Foundations shall be set parallel to track, except as otherwise specified.

1911.

(c) Dimensions of concrete foundations shall be in accordance with the following R. S. A. drawings: 1105, 1107 and 1108, or drawings which shall be submitted or approved by the Purchaser.

1916.

(d) Dimensions for concrete foundations are indicated for level and solid ground. The Purchaser will decide when deviations from specified sizes are necessary.

1916.

4. Air pipe line—Continued.

cock and union at or near its connection with the main.

(n) The main air line must be in good surface and smooth. They shall be connected in line at the bottom of the slopes, and the air line shall be graded, so connected with the main into suitable drain tanks. Auxiliary tanks may be connected in series in the main air line. The tanks shall be provided with by-pass of the same size as the main air line. Tanks, unless they are removed, shall be provided so that auxiliary tanks may be removed without interrupting the flow of air through the by-pass.

(o) The air line when placed above ground parallel to the track shall not be placed nearer than six (6) feet from the gauge side of nearest rail except by special permission.

(p) Local conditions shall determine the height of the main air line above ground, but in all cases the bottom of the pipe shall be not less than six (6) inches above the top of the ground, except by special permission.

(q) Stakes for supports shall be placed not more than ten (10) feet apart.

(r) Red lead, graphite or other equivalent protection for threads must be applied to the pipe threads, and only after pipe connections have been secured when pipe is coupled.

(s) Each length of pipe and the fittings must be free from dirt and scale before being coupled in the line, and care must be exercised that no dirt gets into the line at any time. All pipe lines must be blown out before being connected to any apparatus.

5. Foundations.

(a) Foundations shall be rigid, level, and in good alignment.

(b) Foundations shall be set parallel to track, except as otherwise specified.

(c) Dimensions of concrete foundations shall be in accordance with the following R. S. A. drawings: 1003, 1004 and 1005, or drawings which shall be submitted and approved by the Purchaser.

(d) Dimensions for concrete foundations are indicated for level and solid ground. The Purchaser will decide when deviations from specified sizes are necessary.

270. *Foundations.*—Continued.

(e) Concrete foundations shall stand until properly set before any apparatus is connected thereto or placed thereon. 1915.

(f) Foundations shall be so constructed that apparatus can be removed without disturbing them. 1911.

(g) Dimensions of concrete foundations for other than signal foundations shall be in accordance with ..... drawing ..... 1916.

271. *Signal foundation bolts.*

(a) Foundation bolts for ground masts shall be one (1) inch by thirty-six (36) inches. 1911.

(b) Foundation bolts for bracket signal posts shall be one and one-half (1½) inches by sixty (60) inches. 1915.

280. *Concrete.*

Concrete shall be in accordance with R. S. A. specification. 1916.

SIGNALS

400. *Type and assembly.*

(a) Signals shall be of the semaphore or ..... type. Semaphore signals shall have an arm travel of ..... degrees in the ..... } right }  
quadrant. } left } 1916.

(b) The type of signals (as shown by the R. S. A. symbols) and location of signals shall be in accordance with ..... drawing ..... 1916.

(c) Signals and fittings shall be in accordance with R. S. A. drawings:

1026—Ladders.

1027—Ladders.

1028—Ladders for bracket posts and mechanical bracket masts.

1029—Ladder clamps and stays.

1032—Channel bracket posts.

1033—Mounting for bottom mast. Bracket post.

1034—Base for ground signal mast.

1035—Signal masts.

1036—Base for bridge and bracket masts.

1038—Base for pipe bracket post. Post shall be made of ..... inch and ..... inch steel pipe and water-tight joints.

1039—Pipe bracket post.

1040—Semaphore spectacle, design "A."



- (e) Concrete foundations shall stand with proper set before any apparatus is connected thereto or placed thereon.
- (f) Foundations shall be so constructed that apparatus can be removed without disturbing them.
- (g) Dimensions of concrete foundations for signal posts shall be in accordance with the following table:
- | Height of post   | Width of base | Depth of base |
|------------------|---------------|---------------|
| 10 ft. and under | 18 in.        | 18 in.        |
| 11 ft. to 12 ft. | 24 in.        | 24 in.        |
| 13 ft. to 14 ft. | 30 in.        | 30 in.        |
| 15 ft. and over  | 36 in.        | 36 in.        |

Concrete foundations shall be in accordance with the following table:

Height of post	Width of base	Depth of base
10 ft. and under	18 in.	18 in.
11 ft. to 12 ft.	24 in.	24 in.
13 ft. to 14 ft.	30 in.	30 in.
15 ft. and over	36 in.	36 in.

- Type and assembly.
- (a) Signals shall be of the semaphore or the arm type. Semaphore signals shall have an arm travel of 45 degrees in the right and left positions.
- (b) The type of signal (as shown by the S. S. A. symbols) and location of signals shall be in accordance with the following table:
- | Location    | Type of signal   |
|-------------|------------------|
| At grade    | Semaphore or arm |
| On bridge   | Semaphore or arm |
| At crossing | Semaphore or arm |
- (c) Signals and fittings shall be in accordance with the following table:
- | Location    | Type of signal   |
|-------------|------------------|
| At grade    | Semaphore or arm |
| On bridge   | Semaphore or arm |
| At crossing | Semaphore or arm |

108--Base for bridge and bracket posts and mechanical

109--Channel bracket post.

110--Base for bridge and bracket posts.

111--Base for pipe bracket post. Post shall be

made of 1 1/2 inch and 2 inch steel pipe and

112--Pipe bracket post.

113--Base for bridge and bracket posts.

1041—Semaphore spectacle, design "B."

Lower quadrant signals shall be in accordance with ..... drawing .....  
Light type signals shall be in accordance with ..... drawing .....

1049—Lamp bracket.

1050—Pinnacle.

1052—Ladder foundation.

1059—Clamp for base of ground signal masts.

\*1065—Blades for upper quadrant signals.

1070—Binding post.

1083—"U" bolt and clamp.

1090—Filler block to limit travel of signal arms.

1091—Filler block to limit travel of signal arms.

1093—Diagram of spectacle clearance.

1178—Clamps for base of bridge and bracket masts.

1179—Hand-rail for bracket post.

1235—Semaphore spectacle, design "C."

Roundels shall be in accordance with R. S. A. specification and shall be supplied as follows:

	Color	Diameter inches
Stop .....		(..)
Caution .....		(..)
Proceed .....		(..)
Back light .....		(..)

1916.

(a) Lamps shall be { oil. }  
                                  { convertible. }

(b) Oil lamps shall be in accordance with R. S. A. drawing 1100. 1916.

(c) Convertible lamps shall be equipped with .....  
 ..... (.) incandescent lamps and marine receptacles, in accordance with ..... drawing .....  
 ....., and with oil founts and burners. 1911.

(d) ..... (.) extra incandescent lamps shall  
be furnished. 1911.

\*Blades (wood) for lower quadrant signals shall be in accordance with ..... drawing .....

High blades shall be made of { enameled steel.  
well seasoned ..... }  
Enameled steel blades shall be in accordance with .....  
..... drawing ..... 1916.

1001—Semaphore spectacle design "B"  
Lower quadrant signals shall be in accordance with drawing  
Light type signals shall be in accordance with drawing

1002—Lamp bracket

1003—Pinnacle

1004—Ladder foundation

1005—Blades for upper quadrant signals

1006—Blade post

1007—"U" bolt and clamp

1008—Pillar block to limit travel of signal arms

1009—Diagram of spectacle clearance

1010—Clamps for base of bridge and bracket posts

1011—Hand-rest for bracket post

Signals shall be in accordance with R. S. A. specifications and shall be supplied as follows:

Stop  
Back light

(a) Lamps shall be convertible.  
(b) Oil lamps shall be in accordance with R. S. A. drawing 1012.  
(c) Convertible lamps shall be equipped with incandescent lamps and marine lamps in accordance with drawing 1013 and with oil lamps and burners in accordance with drawing 1014.  
(d) Extra incandescent lamps shall be furnished.

\*Blades (wood) for lower quadrant signals shall be in accordance with drawing 1015.  
High blades shall be made of well seasoned channelled steel in accordance with drawing 1016.

431. *Lamp boxes.*

Lamp boxes shall be in accordance with .....  
drawing ..... 1911.

435. *Signal locations.*

(a) Signal masts shall be on the right of the track governed and adjacent thereto, where practicable. 1911.

(b) Signal arms on tangent shall be at right angles to track governed when sufficient approach is on tangent. On curves signal arms shall be at right angles to imaginary line drawn from the signal to the point where the best view can be obtained by the engineman, as decided by the Purchaser. 1911.

(c) Signals placed between tracks on tangent shall be set so that the center of mast shall be midway between tracks. Signals placed between tracks on curves shall be set off the center line between tracks and towards the center of the curve two and one-half ( $2\frac{1}{2}$ ) inches for each one (1) inch superelevation. 1911.

(d) Before any signals are erected, the Purchaser shall, in the presence of the Contractor's foreman (or other representative), locate each signal. 1911.

(e) Outside of tracks, ground masts shall be placed ..... (..) feet and bracket posts .....  
(..) feet from nearest rail. 1911.

(f) Bridge masts shall be located on .....  
chord of bridge. 1911.

(g) Base of high signals shall be ..... (..) inches below base of rail. 1911.

440. *Electric motor type.*

(a) Motor shall operate arm through [ninety degrees (90)] in [ten (10)] seconds at [one hundred ten (110)] volts normal load, voltage and frequency. 1913.

(b) Motor shall be capable of starting the semaphore from any point in its arc with [thirty-three (33)] per cent. increase in normal torque at normal voltage and frequency. 1913.

(c) Motor shall be capable of starting the semaphore from a standstill at any point in its arc at [ninety (90)] volts with normal torque and frequency, the normal voltage of signal being [one hundred ten (110)]. 1913.



boxes.

Lamp boxes shall be in accordance with

below

#### Signal locations

- (a) Signal posts shall be on the right hand side of the track.
- (b) Signal arms or tangent shall be at right angles to the track. Signal arms shall be at right angles to the track. On curves signal arms shall be at right angles to the track. The distance from the signal to the point where the track view can be obtained by the engineer, as directed by the Engineer.
- (c) Signals placed between tracks on tangent shall be set so that the center of mass shall be midway between tracks. Signals placed between tracks on curves shall be set off the center line between tracks and towards the center of the curve two and one-half (2 1/2) inches for each one (1) inch angle deviation.
- (d) Before any signals are erected, the Engineer shall, in the presence of the Committee between the other representatives, locate each signal.
- (e) On side of track ground marks shall be placed as follows:
  - (1) feet from nearest rail.
  - (2) Bridge marks shall be located on the chord of bridge.
  - (3) Base of high signals shall be
  - (4) inches below base of rail.

#### 440. Electric motor types

- (a) Motor shall operate arm through primary system (90) in ten (10) seconds at one hundred ten (110) volts normal lead voltage and frequency.
- (b) Motor shall be capable of starting the semaphore from any point in its arc with [thirty-three (33) per cent. increase in normal torque at normal voltage and frequency.
- (c) Motor shall be capable of starting the semaphore from a standstill at any point in its arc at thirty (30) per cent. normal torque and frequency, the normal voltage shall be one hundred ten (110).

524. *Cables for high voltage circuits.* (a)—Continued.

B. & S. gauge  $\left\{ \begin{array}{l} \text{solid} \\ \text{stranded} \end{array} \right\} \left\{ \begin{array}{l} \text{copper} \\ \text{.....} \end{array} \right\}$  conductors.

1911.

(b) Underground signal transmission cables shall have

.....  $\left\{ \begin{array}{l} \text{solid} \\ \text{stranded} \end{array} \right\} \left\{ \begin{array}{l} \text{copper} \\ \text{.....} \end{array} \right\}$  conductors No.....

..... (..) B. & S. gauge and ..... (..) No. .... (..)

B. & S. gauge  $\left\{ \begin{array}{l} \text{solid} \\ \text{stranded} \end{array} \right\} \left\{ \begin{array}{l} \text{copper} \\ \text{.....} \end{array} \right\}$  conductors.

1911.

(c) Submarine signal transmission cables shall have

.....  $\left\{ \begin{array}{l} \text{solid} \\ \text{stranded} \end{array} \right\} \left\{ \begin{array}{l} \text{copper} \\ \text{.....} \end{array} \right\}$  conductors No.....

B. & S. gauge  $\left\{ \begin{array}{l} \text{solid} \\ \text{stranded} \end{array} \right\} \left\{ \begin{array}{l} \text{copper} \\ \text{.....} \end{array} \right\}$  conductors.

1911.

525. *Wiring.*

(a) Wires in trunking, chases or conduits shall be laid loosely without stretching or crowding.

1911.

(b) Not more than two (2) wires shall be connected to one (1) binding post or terminal screw.

1911.

526. *Common return.*

(a) Reductions in size of common wire and connections to pole lines shall be made in junction boxes.

(b) Connections between branches and main common wires shall be made in junction boxes.

1911.

527. *Joints in wire.*

(a) Wires shall, as far as practicable, be continuous without joints or breaks; joints shall be made only on permission from the Engineer.

1911.

(b) In making joints, braid shall be pulled back one (1) inch from end of rubber on each side of splice, and rubber cut with knife held at an angle of approximately thirty (30) degrees with axis of wire, as one would sharpen a pencil.

1911.

(c) After removing rubber, wire shall be thoroughly cleaned, care being taken to prevent injury from small cuts or nicks.

1911.

(d) Wire, after being cleaned, shall be twisted together in the form of a regular line wire splice, turns being spaced approximately one-sixty-fourth ( $1/64$ ) inch.

1911.

(e) Joints shall then be soldered by pouring on them, or dipping them into melted solder, a non-corrosive flux being used. After soldering, joints shall be covered with two (2) layers of rubber insulating tape between ends of

# Railway Signal Association

Cables for high voltage conductors (a) Continued.

B. & S. gauge { solid { copper { conductors

(b) Underground signal transmission cables shall have

{ solid { copper { conductors No. {

{ stranded { B. & S. gauge and { No. {

{ solid { copper { conductors {

{ stranded { B. & S. gauge { conductors No. {

{ solid { copper { conductors No. {

{ stranded { B. & S. gauge { conductors {

Wiring.

(a) Wires in running, cables or conductors shall be laid

loosely without stretching or crowding

(b) Not more than two (2) wires shall be connected to

(a) Reductions in size of common wire and connections to pole lines shall be made in junction boxes

(b) Connections between branches and main common

(a) Wires shall, as far as practicable, be continuous without joints or breaks. Joints shall be made only on

(b) In making joints, wires shall be pulled back one (1)

inch from end of rubber on each side of splice, and

rubber cut with knife held at an angle of approximately

thirty (30) degrees with wire of wire, as one would

sharpen a pencil.

(c) After removing rubber, wire shall be thoroughly

cleaned, care being taken to prevent injury from small

cuts or nicks.

(d) Wire, after being cleaned, shall be twisted to-

gether in the form of a regular line wire splice, being

ing spaced approximately one-sixth (1/6) inch

(e) Joints shall then be soldered by pouring on them

or dipping them into melted solder, a non-corrosive flux

being used. After soldering, joints shall be covered with

two (2) layers of rubber insulating tape between ends of

527. *Joints in wire.* (e)—Continued.

braid, which tape shall be heated sufficiently to form a tight covering, but not enough to injure the quality of the material; insulating tape shall be in accordance with R. S. A. specification for "Rubber Insulating Tape." Two (2) layers of friction tape shall be applied over the rubber insulation and the ends of the braiding, and this tape shall then be thoroughly coated with black asphaltum paint. The friction tape shall be in accordance with R. S. A. specification for "Friction Tape." 1916.

528. *Fuses.**Material.*

(a) Fuses shall be of the enclosed type, in accordance with R. S. A. drawing 1309. Fuse clips shall be mounted on an insulating base of fireproof material. 1915.

*Field work.*

(b) The necessary fuses to properly protect all apparatus and circuits shall be installed. 1911.

(c) Fuses outside of buildings shall be enclosed in weatherproof boxes. 1911.

(d) In the lighting circuits, a fuse shall be provided in the circuit to each signal lamp; in the circuit to each set of lamps on a mast; in each branch circuit leaving the mains, and in each set of mains leaving the switchboard. 1911.

530. *Tags.**Material.*

(a) Tags shall be made of vulcanized sheet fibre, not less than one-sixteenth ( $1/16$ ) inch thick, firmly attached to the wire by the best quality yacht marline one-sixteenth ( $1/16$ ) inch in diameter. 1911.

(b) The tag shall have a stamped imprint to show the function of the wire. 1911.

*Field work.*

(c) Wires shall be tagged at all junction boxes, switches, signals, relay boxes, arrester boxes, and at all line wire connections, unless otherwise specified. 1911.

532. *Petroleum asphaltum.**Material.*

(a) Petroleum asphaltum shall be in accordance with R. S. A. specifications. 1916.

*Field work.*

(b) When specified, the wires in the trunking shall be loosely bound and shall be so laid in pitch as to be practically free of contact with all walls of the trunking. 1911.



Joint in wire. (e) - Continued.

braids, which shall be heated sufficiently to form a  
right covering, but not enough to injure the quality of  
the material. Insulating tape shall be in accordance with  
R. S. A. specification for "Rubber Insulating Tape". Two  
(a) layers of friction tape shall be applied over the rub-  
ber insulation and the ends of the braiding and this tape  
shall then be thoroughly caulked with white lead and  
paint. The friction tape shall be in accordance with  
R. S. A. specification for "Friction Tape".

288. Fuses.

Material.

(a) Fuses shall be of the enclosed type in accordance  
with R. S. A. drawing type. They shall be made of  
on an insulating base of fireproof material.

Field work.

(b) The necessary fuses to properly protect all ap-  
paratus and circuits shall be installed.  
(c) Fuses outside of buildings shall be enclosed in  
a box.  
(d) In the lighting circuit, a fuse shall be provided in  
the circuit to each signal lamp. In the circuit to each set  
of lamps on a mast in each station circuit leaving the  
main, and in each set of main leaving the station board.

(e) Tags shall be made of unvarnished sheet brass, not  
less than one-sixteenth (1/16) inch thick, firmly attached  
to the wire by the best quality yacht marine one-sixteenth  
(1/16) inch in diameter.  
(f) The tag shall have a stamped marking to show the  
function of the wire.

Field work.

(g) Wires shall be tagged at all junction boxes,  
switches, signal relay boxes, arrestor boxes, and at all

(a) Petroleum asphaltum shall be in accordance with  
R. S. A. specifications.

Field work.

(b) When specified, the wire in the trailing shall be  
loosely banded and shall be so laid in such as to be prac-  
tically free of contact with all walls of the running  
groove.

532. *Petroleum asphaltum.*—Continued.

(c) When petroleum asphaltum is used, terminal box bootlegs, trunking and bootleg terminals shall be in accordance with R. S. A. drawings 1154, 1155, 1156 and 1157. 1916.

BONDING

(When propulsion, bonding is not required.)

540. *Bonding wires.*

*Material.*

(a) Bonding wires shall be in accordance with R. S. A. specification. 1916.

*Field work.*

(b) Number six (6) B. & S. gauge bare copper or copper-clad steel bonding wires shall be used. 1911.

(c) Bonding shall be in accordance with ..... drawing ..... Rail joints, except as below, shall be bonded with two (2) number six (6) B. & S. gauge bonding wires. Where joints are located in platforms or road crossings, whether of plank, brick, or ballast filling, four (4) wires must be used at each joint, two (2) being placed on either side of rail and outside of angle bar. 1911.

(d) Frogs shall be bonded in the same manner as the rail joints and shall be so connected, that the continuity of the track circuit will be broken when they are removed from the track. 1911.

542. *Channel pins.*

*Material.*

(a) Channel pins shall be in accordance with R. S. A. specification. Single channel pins shall be in accordance with R. S. A. drawing 1086. 1916.

*Field work.*

(b) Each bond wire shall be fastened at each end into the web of the rail by a channel pin. 1911.

(c) Channel pins shall be driven the same day that holes are drilled. 1911.

IMPEDANCE BONDS

543. *Impedance bonds.*

Impedance bonds shall be in accordance with R. S. A. specifications. 1916.

544. *Impedance coils.*

Impedance coils shall be in accordance with ..... specifications. 1913.

CONTROL APPARATUS

600. *Relays.*

Relays shall be in accordance with R. S. A. specifications for "Alternating Current Relays." 1916.

is used, terminals for  
connecting terminals shall be in ac-  
cordance with R. S. A. drawings 114, 115, 116 and  
117.

(When provision, bonding is not required)

540. Bonding wires.

Material.

(a) Bonding wires shall be in accordance with R. S. A.  
specification.

(b) Number six (6) or larger steel bonding wires shall be used.  
(c) Bonding shall be in accordance with

Number six (6) R. S. A. drawings 114, 115, 116 and 117.  
The bonding wires shall be placed in the  
holes or slots of the plate or between the  
plates and wires shall be secured at each joint and  
the ends of the wires shall be outside of the plate.

(d) Hooks shall be bonded in the same manner as the  
tail joints and shall be so placed that the  
of the track circuit will be broken when they are removed.

Material.

shall be in accordance with R. S. A.  
specification.

(b) Each bond wire shall be fastened at each end into  
the web of the rail by a channel pin.

(c) Channel pins shall be driven the same day that

Impedance bonds shall be in accordance with R. S. A.  
specification.

Impedance bonds shall be in accordance with

CONTROL APPARATUS

Relays

Relays shall be in accordance with R. S. A. specifica-  
tions for "Alternating Current Relays".

CONTROL APPARATUS

600. *Relays.*

Relays shall be in accordance with R. S. A. specification  
for "Alternating Current Relays." 1916.

610. *Circuit controllers.*

*Material.*

(a) Circuit controllers of substantial construction and positive in action shall be provided for track switches as specified and shall be so constructed that they can be maintained to make or break circuit when switch point shall be moved from the closed position three-sixteenths ( $3/16$ ) of an inch. 1911.

(b) Operating rods of switch circuit controllers shall be not less than three-fourths ( $3/4$ ) inch in diameter and adjustable, with a maximum distance of three (3) feet between supports. 1915.

(c) Circuit controllers for non-interlocked switches shall have two independent shunt connections from the circuit controllers to the track circuits of each track affected by the opening of switch and shall shunt tracks when switch point shall have been opened from the closed position three-sixteenths ( $3/16$ ) or ..... (..) of an inch. 1915.

(d) Lever and latch circuit controllers shall have ..... (..) fingers ..... (..) normally open and ..... (..) closed contacts. 1911.

(e) Circuit controllers for switch points, movable point frogs or derails shall have ..... (..) fingers with ..... (..) normally open and ..... (..) closed contacts. 1911.

(f) Drawbridge circuit controllers shall have ..... (..) fingers with ..... (..) normally open and ..... (..) closed contacts. 1911.

(g) Circuit controllers for mechanically interlocked signals shall have ..... (..) fingers with ..... (..) open and ..... (..) closed contacts. 1911.

(h) Current carrying parts shall be capable of breaking ..... (..) amperes at ..... (..) volts.

*Field work.*

(i) The switch circuit controller shall be positively connected to one or both points; if but one point, the normally ..... shall be selected. 1911.

(j) The switch circuit controller shall be insulated from the tie plate and from the track. 1911.



YANNUA 1971

(a) Circuit controller shall be provided for each position in which the circuit is to be operated and shall be provided with a means of locking the circuit in the closed position. The locking device shall be provided with a means of locking the circuit in the closed position. The locking device shall be provided with a means of locking the circuit in the closed position.

(b) Operating switch of switch controller shall be provided with a means of locking the circuit in the closed position.

(c) Circuit controller shall be provided with a means of locking the circuit in the closed position. The locking device shall be provided with a means of locking the circuit in the closed position. The locking device shall be provided with a means of locking the circuit in the closed position.

(d) Circuit controller shall be provided with a means of locking the circuit in the closed position. The locking device shall be provided with a means of locking the circuit in the closed position. The locking device shall be provided with a means of locking the circuit in the closed position.

(e) Circuit controller shall be provided with a means of locking the circuit in the closed position. The locking device shall be provided with a means of locking the circuit in the closed position. The locking device shall be provided with a means of locking the circuit in the closed position.

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(g) Circuit controller shall be provided with a means of locking the circuit in the closed position. The locking device shall be provided with a means of locking the circuit in the closed position. The locking device shall be provided with a means of locking the circuit in the closed position.

(h) Circuit controller shall be provided with a means of locking the circuit in the closed position. The locking device shall be provided with a means of locking the circuit in the closed position. The locking device shall be provided with a means of locking the circuit in the closed position.

# SPECIFICATIONS AND REQUISITES OF APPARATUS AND MATERIAL FOR ALTERNATING CURRENT AUTO- MATIC BLOCK SIGNAL SYSTEM.

(On railways using direct current for propulsion.)

1912.

Revised 1916.

To be installed at.....  
on the ..... R.....

INDEX.	Section.
Air compressor .....	63
Air pipe line.....	98
Arresters, lightning .....	635
boxes .....	722
Bolts, signal foundation .....	271
Bonding .....	540 to 550
wires .....	540
Bootlegs .....	708
Boxes, junction .....	710
cable .....	718
lightning arrester .....	722
relay .....	720
Buildings .....	50 to 60
foundations .....	50
painting .....	840
Cable boxes .....	718
Cables for high voltage circuits.....	524
for low voltage circuits.....	522
Channel pins .....	542
Circuits .....	500 to 520
electric lighting .....	506
practice .....	500
special .....	510
track .....	502
switchboard .....	501
Common return .....	526
Compressor, air .....	63
Concrete .....	280
Condensers .....	95
Conduits and supports.....	711

# INSTRUCTIONS AND REQUIREMENTS OF APPARATUS AND MATERIAL FOR ALTERNATING CURRENT AUTO- MATIC BLOCK SIGNAL SYSTEM.

(On railways using direct current for propulsion.)

1915.

Revised 1916.

To be installed at  
on the

## INDEX.

Lesser	.....	1
.....	.....	2
.....	.....	3
.....	.....	4
.....	.....	5
.....	.....	6
.....	.....	7
.....	.....	8
.....	.....	9
.....	.....	10
.....	.....	11
.....	.....	12
.....	.....	13
.....	.....	14
.....	.....	15
.....	.....	16
.....	.....	17
.....	.....	18
.....	.....	19
.....	.....	20
.....	.....	21
.....	.....	22
.....	.....	23
.....	.....	24
.....	.....	25
.....	.....	26
.....	.....	27
.....	.....	28
.....	.....	29
.....	.....	30
.....	.....	31
.....	.....	32
.....	.....	33
.....	.....	34
.....	.....	35
.....	.....	36
.....	.....	37
.....	.....	38
.....	.....	39
.....	.....	40
.....	.....	41
.....	.....	42
.....	.....	43
.....	.....	44
.....	.....	45
.....	.....	46
.....	.....	47
.....	.....	48
.....	.....	49
.....	.....	50
.....	.....	51
.....	.....	52
.....	.....	53
.....	.....	54
.....	.....	55
.....	.....	56
.....	.....	57
.....	.....	58
.....	.....	59
.....	.....	60
.....	.....	61
.....	.....	62
.....	.....	63
.....	.....	64
.....	.....	65
.....	.....	66
.....	.....	67
.....	.....	68
.....	.....	69
.....	.....	70
.....	.....	71
.....	.....	72
.....	.....	73
.....	.....	74
.....	.....	75
.....	.....	76
.....	.....	77
.....	.....	78
.....	.....	79
.....	.....	80
.....	.....	81
.....	.....	82
.....	.....	83
.....	.....	84
.....	.....	85
.....	.....	86
.....	.....	87
.....	.....	88
.....	.....	89
.....	.....	90
.....	.....	91
.....	.....	92
.....	.....	93
.....	.....	94
.....	.....	95
.....	.....	96
.....	.....	97
.....	.....	98
.....	.....	99
.....	.....	100

2  
*Railway Signal Association.*

A.C. Automatic  
Block Signals.  
D.C. Propulsion.  
Index to  
Specifications.

	Section.
Control apparatus .....	610 to 650
Controllers, circuit .....	610
Detail provisions .....	50 to 950
Distributing system .....	98 to 100
Electric lighting circuits .....	506
locks .....	615
Electrical requirements .....	30
Engine .....	51
Fibre, insulating .....	748
Foundation bolts, signal.....	271
Foundations .....	270
building .....	50
Fuses .....	528
General provisions (See unit specification).	
Generator .....	65
Impedance bonds .....	543
Impedance coils .....	544
Indicators .....	625
Instrument shelter .....	720 to 735
Insulated rail joints.....	735
Insulating fibre .....	748
Insulations .....	735 to 800
pipe line .....	742
switch rod .....	738
tie plating .....	744
Iron work, painting .....	810
Joints in wire .....	527
rail, insulated .....	735
trunking .....	703
Junction boxes .....	710
terminals .....	928
Lamps .....	430
Lamp boxes .....	431
Lighting .....	54
Lightning arrester boxes .....	722
arresters .....	635
Line construction .....	714
Line supports .....	715
Locations, signal .....	435
Locks .....	925
electric .....	615
time .....	622
Motor .....	70
Motor generator .....	75
Number plates and numbers.....	926



Section 1

Control apparatus	510 to 520
Control apparatus	520 to 530
Control apparatus	530 to 540
Control apparatus	540 to 550
Control apparatus	550 to 560
Control apparatus	560 to 570
Control apparatus	570 to 580
Control apparatus	580 to 590
Control apparatus	590 to 600
Control apparatus	600 to 610
Control apparatus	610 to 620
Control apparatus	620 to 630
Control apparatus	630 to 640
Control apparatus	640 to 650
Control apparatus	650 to 660
Control apparatus	660 to 670
Control apparatus	670 to 680
Control apparatus	680 to 690
Control apparatus	690 to 700
Control apparatus	700 to 710
Control apparatus	710 to 720
Control apparatus	720 to 730
Control apparatus	730 to 740
Control apparatus	740 to 750
Control apparatus	750 to 760
Control apparatus	760 to 770
Control apparatus	770 to 780
Control apparatus	780 to 790
Control apparatus	790 to 800
Control apparatus	800 to 810
Control apparatus	810 to 820
Control apparatus	820 to 830
Control apparatus	830 to 840
Control apparatus	840 to 850
Control apparatus	850 to 860
Control apparatus	860 to 870
Control apparatus	870 to 880
Control apparatus	880 to 890
Control apparatus	890 to 900
Control apparatus	900 to 910
Control apparatus	910 to 920
Control apparatus	920 to 930
Control apparatus	930 to 940
Control apparatus	940 to 950
Control apparatus	950 to 960
Control apparatus	960 to 970
Control apparatus	970 to 980
Control apparatus	980 to 990
Control apparatus	990 to 1000

	Section.
Painting .....	800 to 900
buildings .....	840
Paint .....	800
iron work .....	810
wood work .....	830
Petroleum asphaltum .....	532
Pins, channel .....	542
Pipe line insulation .....	742
Plant .....	60
Power house .....	52
Rail joints, insulated .....	735
Relay boxes .....	720
cases .....	721
Releases, hand .....	618
Roundels .....	425
Shelter, grid or unit .....	724
transformer .....	723
Signal locations .....	435
Signals .....	400 to 500
electric motor type .....	440
electro-pneumatic type .....	442
light type .....	443
solenoid type .....	441
Special circuits .....	510
items .....	900 to 950
Supply, main .....	76
auxiliary .....	77
Supports, high voltage cable .....	717
line .....	715
trunking .....	705
Switchboards .....	90
circuits .....	501
Switch indicators .....	625
rod insulations .....	738
Tags .....	530
Tie plate insulations .....	744
Track circuits .....	502
Transformers .....	80
shelter .....	723
Trunking .....	700 to 710
supports .....	705
joints .....	703
Type and assembly of signals .....	400



---

	Section.
Wire and wiring .....	520 to 540
bonding .....	540
joints .....	527
line for high voltage circuit.....	523
sizes .....	521
specifications .....	520
Wiring .....	525
Wood work, painting.....	830





SPECIFICATIONS AND REQUISITES OF APPARATUS AND  
MATERIAL FOR ALTERNATING CURRENT AUTO-  
MATIC BLOCK SIGNAL SYSTEM.

(On railways using direct current for propulsion.)

1912.

Revised 1916.

GENERAL PROVISIONS OF SPECIFICATIONS FOR  
SIGNAL INSTALLATIONS.

(See unit specification covering the text of these provisions indexed  
under Subdivision G.)

*Note.*—This unit specification has been adopted as of January 10, 1917, to take the place of the "General Provisions," heretofore forming a part of these specifications. This sheet is numbered 1 to 5, in order to obviate the necessity of having the existing subject matter reprinted.

Block Signals  
D.C. System  
Specifications

THE LIBRARY  
OF THE  
RAILWAY SIGNAL ASSOCIATION  
AND  
MATERIAL FOR ALTERNATING CURRENT AUTO-  
MATIC BLOCK SIGNAL SYSTEM

1000  
SIGNAL INSTALLATIONS  
GENERAL SPECIFICATIONS FOR THE INSTALLATION OF  
SIGNAL INSTALLATIONS

This unit specification covering the text of these provisions indexed  
under Subdivision (C)

—This unit specification has been adopted as of January 1900  
to take the place of the "General Provisions," heretofore form  
a part of these specifications. This sheet is numbered 1 to 2, in  
order to obviate the necessity of having the existing subject matter

## GENERAL ELECTRICAL REQUIREMENTS.

### 30 ■ General electric requirements.

(a) Electric apparatus shall withstand an insulation test at the place of manufacture of three thousand (3000) volts a.c. for one (1) minute. 1911.

(b) Magnets and solenoids shall be plainly marked with their resistance and the size of wire with which they are wound. 1911.

(c) Windings shall be treated in accordance with R. S. A. specifications for "Impregnation Treatment for Coils and Windings." 1916.

## DETAIL PROVISIONS.

### BUILDINGS

#### 50. Foundations.

(a) Foundations shall be provided by the ..... in accordance with specifications and drawings ..... dated ..... 1916.

(b) The foundation for interlocking station leadout supports shall be furnished in place by the ..... in accordance with R. S. A. drawings 1200, 1203, or 1217. 1916.

#### 52. Power house.

Building shall be provided by the ..... in accordance with specifications and drawings ....., dated ..... 1916.

#### 54. Lighting.

(a) The lighting for buildings shall be installed by ..... 1911.

(b) The type of fixtures, numbers, kind, size and switch control of electric lamps shall be in accordance with .... specifications and drawing ..... dated .....; lamps distributed as follows:

	Number.	Watts per Lamp.
Operating room	..... (..)	..... (..)
Tower room	..... (..)	..... (..)
Battery room	..... (..)	..... (..)
Generator room	..... (..)	..... (..)
Special	..... (..)	..... (..)

1916.





54. *Lighting.*—Continued.

(c) Fixtures for electric lighting shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

(d) Fixtures and accessories for electric lamps shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

POWER SUPPLY

60. *Plant.\**

(a) The power plant shall consist of .....  
 ..... 1916.

(b) .....  
 shall be furnished by ..... and installed  
 by ..... 1916.

(c) .....  
 shall be furnished by ..... and installed  
 by ..... 1916.

61. *Engine.*

(a) A ..... (..) cylinder ..... (..)  
 cycle { vertical } { steam } engine of ..... (..)  
       { horizontal } { air }  
       { turbine }  
 brake horse-power, manufactured by ....., in-  
 stalled by ....., the ..... shall be fur-  
 nished on a ..... foundation, to be furnished in  
 place by the ....., constructed in accordance  
 with the standard specifications of the ..... and  
 drawings of the Manufacturer of the engine numbers  
 ....., dated ..... 1916.

(b) Gasoline engines, fuel and water tanks shall conform to R. S. A. specifications. 1916.

(c) Engines shall be of such type as to be easily accessible for attention to bearings, adjusting and cleaning. 1916.

(d) Contractor shall furnish sufficient material for installation of muffler outside of building with as few turns and bends as practicable. 1916.

(e) A complete set of wrenches shall be furnished. 1911.

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\*R. S. A. drawings 1388 and 1389 may be used as guides in determining the parts of each plant, which may then be specified in Section 60.



61. *Engine.*—Continued.

(f) Exposed piping subject to excessive heat shall be protected with { asbestos } covering. 1916.

63. *Air compressor.*

A { one } stage air compressor of ..... (..)  
two } indicated horsepower, capacity of ..... (..) cubic  
feet of free air per minute at ..... (..) feet  
elevation above sea level, and designed for air pressure  
of ..... (..) pounds, manufactured by .....  
....., installed by the ....., shall be furnished  
on a ..... foundation, to be furnished in  
place by the ....., constructed in accordance  
with the standard specifications of the .....,  
and drawings of the Manufacturer. 1911.

65. *Generator.*

The electric generator shall be in accordance with  
R. S. A. specifications. 1916.

70. *Motor.*

The motor shall be ..... (..) horsepower,  
with a rated speed not to exceed ..... (..) r. p. m., if direct current, or one thousand eight hundred  
(1800) r. p. m., if alternating current, and shall have auto-  
matic regulation to within twenty (20) per cent., when  
operating on ..... (..) to ..... (..) volts d.c., or on ..... (..) to ..... (..) volts ..... (..) cycles ..... (..) phase a.c., shall be in accordance with R. S. A.  
specification for "Electric Generators" regarding heat-  
ing, sparking and insulation, and shall be furnished with  
a starting panel. 1916.



.5161

98. *Air pipe line.* (j)—Continued.

and expansion joints, is shown on ..... drawing,  
..... 1911.

(k) Connections to the branch air line must be made  
from the top of the main air line. 1911.

(l) Unless otherwise specified, an auxiliary reservoir  
shall be connected in each branch air line for each switch  
unit, and for each signal or group of signals. Auxiliary  
reservoirs shall have capacity sufficient to collect all con-  
densation from the air line, and shall be provided with  
means for blowing off condensation. An air strainer shall  
be inserted in the outlet pipe of each auxiliary reservoir.  
1915.

(m) Each branch line must contain a combined brass  
cock and union at or near its connection with the main.

(n) The main air line must be in good surface and aux-  
iliary tanks connected in line at the bottom of all slopes,  
and the air line shall be graded, so condensation will run  
into suitable drain tanks. Auxiliary tanks shall be con-  
nected in series with the main air line and be provided  
with by-pass of the same size as the main air line. Flanges,  
unions, gate valves, etc., shall be provided so  
that auxiliary tanks may be removed without interrupt-  
ing the flow of air through the by-pass. 1915.

(o) The air line when placed above ground parallel to  
the track shall not be placed nearer than six (6) feet  
from the gauge side of nearest rail except by special per-  
mission. 1911.

(p) Local conditions shall determine the height of the  
main air line when above ground, but in all cases the bot-  
tom of the pipe shall be not less than six (6) inches above  
the top of the ground, except by special permission. 1915.

(q) Stakes for supports shall be placed not more than  
ten (10) feet apart. 1911.

(r) Red lead, graphite or other equivalent protections  
for threads must be applied to the pipe threads and only  
after pipe connections have been started when pipe is  
coupled. 1915.

(s) Each length of pipe and the fittings must be free  
from dirt and scale before being coupled in the line, and  
care must be exercised that no dirt gets into the line at  
any time. All pipe lines must be blown out before being  
connected to any apparatus. 1911.

FOUNDATIONS

270. *Foundations.*

*Field work.*

(a) Foundations shall be rigid, level, and in good align-  
ment. 1916.

(b) Foundations shall be set parallel to track, except as  
otherwise specified. 1911.

88. Air pipe line. (i)—Continued.

and expansion joints, is shown on ..... drawing.

(k) Connections to the branch air line must be made from the top of the main air line.

(l) Unless otherwise specified, an auxiliary reservoir shall be connected in each branch air line. Auxiliary unit, and for each signal or group of signals, reservoir shall have capacity sufficient to collect all means for blowing off condensation. An air reservoir shall be inserted in the outlet pipe of each auxiliary reservoir.

(m) Each branch line must contain a combined break cock and union at or near its connection with the main

(n) The main air line must be in good surface and auxiliary tanks connected in line at the bottom of all slopes, and the air line shall be graded so condensation will run into suitable drain tanks. Auxiliary tanks shall be connected in series with the main air line and be provided with by-pass of the same size as the main air line. Flanges, unions, gate valves, etc., shall be provided so that auxiliary tanks may be removed without interrupting the flow of air through the by-pass.

(o) The air line when placed above ground parallel to the track shall not be placed nearer than six (6) feet from the gauge side of nearest rail except by special per-

(p) Local conditions shall determine the height of the main air line above ground, but in all cases the bottom of the pipe shall be not less than six (6) inches above the top of the ground, except by special permission.

(q) Stakes for supports shall be placed not more than ten (10) feet apart.

(r) Red lead, graphite or other equivalent protection for threads must be applied to the pipe threads and after pipe connections have been started when pipe is

(s) Each length of pipe and the fittings must be free from dirt and scale before being coupled in the line and care must be exercised that no dirt gets into the line at any time. All pipe lines must be blown out before being connected to any apparatus.

FOUNDATIONS

Field work.

(a) Foundations shall be rigid, level and in good align-

(b) Foundations shall be set parallel to track, except as otherwise specified.

270. *Foundations.*—Continued.

(c) Dimensions of concrete foundations shall be in accordance with the following R. S. A. drawings: 1105, 1107 and 1108, or drawings which shall be submitted or approved by the Purchaser. 1916.

(d) Dimensions for concrete foundations are indicated for level and solid ground. The Purchaser will decide when deviations from specified sizes are necessary. 1916.

(e) Concrete foundations shall stand until properly set before any apparatus is connected thereto or placed thereon. 1915.

(f) Foundations shall be so constructed that apparatus can be removed without disturbing them. 1915.

(g) Dimensions of concrete foundations for other than signal foundations shall be in accordance with ..... drawing ..... 1916.

271. *Signal foundation bolts.*

(a) Foundation bolts for ground masts shall be one (1) inch by thirty-six (36) inches. 1911.

(b) Foundation bolts for bracket signal posts shall be one and one-half (1½) inches by sixty (60) inches. 1915.

280. *Concrete.*

Concrete shall be in accordance with R. S. A. specifications. 1916.

SIGNALS

400. *Type and assembly.*

(a) Signals shall be of the semaphore or ..... type. Semaphore signals shall have an arm travel of ..... degrees in the ..... { right }  
quadrant { left } 1916.

(b) The type of signals (as shown by the R. S. A. symbols) and location of signals shall be in accordance with ..... drawing ..... 1916.

(c) Signals and fittings shall be in accordance with R. S. A. drawings:

1026—Ladders.

1027—Ladders.

1028—Ladders for bracket posts and mechanical bracket masts.

1029—Ladder clamps and stays.

1032—Channel bracket posts.

1033—Mounting for bottom mast. Bracket post.

1034—Base for ground signal mast.





400. *Type and assembly.* (c)—Continued.

- 1035—Signal masts.
- 1036—Base for bridge and bracket masts.
- 1038—Base for pipe bracket post. Post shall be  
           made of ..... inch and .....  
           inch steel pipe and water-tight joints.
- 1039—Pipe bracket post.
- 1040—Semaphore spectacle, design "A."
- 1041—Semaphore spectacle, design "B."  
           Lower quadrant signals shall be in ac-  
           cordance with ..... drawing  
           ..... Light type signals shall  
           be in accordance with .....  
           drawing .....
- 1049—Lamp bracket.
- 1050—Pinnacle.
- 1052—Ladder foundation.
- 1059—Clamp for base of ground signal masts.
- \*1065—Blades for upper quadrant signals.
- 1070—Binding post.
- 1083—"U" bolt and clamp.
- 1090—Filler block to limit travel of signal arms.
- 1091—Filler block to limit travel of signal arms.
- 1093—Diagram of spectacle clearance.
- 1178—Clamps for base of bridge and bracket masts.
- 1179—Hand-rail for bracket post.
- 1235—Semaphore spectacle, design "C."

425. *Roundels.*

Roundels shall be in accordance with R. S. A. specifica-  
 tion and shall be supplied as follows:

	Color	Diameter Inches
Stop .....		(.)
Caution .....		(.)
Proceed .....		(.)
Back light .....		(.)
		1916.

---

\*Blades (wood) for lower quadrant signals shall be in  
 accordance with ..... drawing .....

High blades shall be made of { enameled steel.  
   } well seasoned ..... {

Enameled steel blades shall be in accordance with .....  
 ..... drawing ..... 1916.



430. *Lamps.*

(a) Lamps shall be  $\left\{ \begin{array}{l} \text{oil.} \\ \text{convertible.} \end{array} \right\}$  1911.

(b) Oil lamps shall be in accordance with R. S. A. drawing 1100. 1916.

(c) Convertible lamps shall be equipped with .....  
..... (..) incandescent lamps and marine receptacles, in accordance with ..... drawing .....  
....., and with oil founts and burners. 1911.

(d) ..... (..) extra incandescent lamps shall be furnished. 1911.

431. *Lamp boxes.*

Lamp boxes shall be in accordance with .....  
drawing ..... 1911.

435. *Signal locations.*

(a) Signal masts shall be on the right of the track governed and adjacent thereto where practicable. 1911.

(b) Signal arms on tangent shall be at right angles to track governed when sufficient approach is on tangent. On curves signal arms shall be at right angles to imaginary line drawn from the signal to the point where the best view can be obtained by the engineman, as decided by the Purchaser. 1911.

(c) Signals placed between tracks on tangent shall be set so that the center of mast shall be midway between tracks. Signals placed between tracks on curves shall be set off the center line between tracks and towards the center of the curve two and one-half ( $2\frac{1}{2}$ ) inches for each one (1) inch superelevation. 1911.

(d) Before any signals are erected, the Purchaser shall, in the presence of the Contractor's foreman (or other representative), locate each signal. 1911.

(e) Outside of tracks, ground masts shall be placed ..... (..) feet and bracket posts .....  
(..) feet from nearest rail. 1911.

(f) Bridge masts shall be located on .....  
chord of bridge. 1911.

(g) Base of high signals shall be ..... (..) inches below base of rail. 1911.

440. *Electric motor type.*

(a) Motor shall operate arm through [ninety degrees (90)] in [ten (10)] seconds at [one hundred ten (110)] volts normal load, voltage and frequency. 1913.

(b) Motor shall be capable of starting the semaphore from any point in its arc with [thirty-three (33)] per cent. increase in normal torque at normal voltage and frequency. 1913.



435. Signal locations.

(a) Signal masts shall be on the right of the track governed and adjacent thereto where practicable.

(b) Signal arms on tangent shall be at right angles to track governed when tangent approach is on tangent. On curves signal arms shall be at right angles to tangent line drawn from the signal to the point where the best view can be obtained by the engineer, as decided by the Purchaser.

(c) Signals placed between tracks on tangent shall be set so that the center of mast shall be midway between tracks. Signals placed between tracks on curves shall be set off the center line between tracks and towards the center of the curve two and a-half (2½) feet for each one (1) inch super-elevation.

(d) Before any signals are erected, the Purchaser shall, in the presence of the Contractor's foreman (or other representative), locate each signal.

(e) Outside of track, ground masts shall be placed . . . . . (1) feet and lowest posts . . . . . (1) feet from nearest rail.

(f) Bridge masts shall be located on . . . . . chord of bridge.

(g) Base of high signals shall be . . . . . inches below base of rail.

(h) Motor shall operate arm through pinkey gears (90) in [ten (10)] seconds at [one hundred ten (110)] volts normal load, voltage and frequency.

(i) Motor shall be capable of starting the semaphore from any point in its arc with [thirty (30)] psi.

(j) Lamp boxes . . . . . be furnished.

(k) Convertible lamps shall be equipped with . . . . . incandescent lamps . . . . . in accordance with . . . . . and with oil lamps and . . . . .

(l) Oil lamps shall be . . . . . convertible.

(a) Aerial cables shall have ..... { solid }  
stranded }  
{ copper } conductors, No. .... B. & S. gauge  
and ..... No. .... B. & S. gauge  
{ solid } { copper }  
{ stranded } { ..... } conductors. 1911.  
(b) Underground signal cables shall have .....  
{ solid } { copper }  
{ stranded } { ..... } conductors No. ....  
B. & S. gauge and ..... No. .... B. & S.  
gauge { solid } { copper }  
{ stranded } { ..... } conductors. 1911.  
(c) Submarine cables shall have .....  
{ solid } { copper }  
{ stranded } { ..... } conductors No. ....  
B. & S. gauge and ..... No. .... B. & S.  
gauge { solid } { copper }  
{ stranded } { ..... } conductors. 1911.

Signal transmission line shall be No. .... (.)

B. & S. gauge { solid } { bare }  
                  { stranded } { insulated }

{ copper }  
{ ..... } conductor.

1911.

(a) Aerial signal transmission cables shall have .....  
 ..... (..) { solid } { copper } conductors No. ....  
 ..... (..) { stranded } { ..... }  
 ..... (..) B. & S. gauge and ..... (..) No. .... (..)  
 B. & S. gauge { solid } { copper } conductors, 1911.  
 ..... { stranded } { ..... }

(b) Underground signal transmission cables shall have  
 ..... (..) { solid } { copper } conductors No. ....  
 ..... (..) { stranded } { ..... }  
 ..... (..) B. & S. gauge and ..... (..) No. .... (..)  
 B. & S. gauge { solid } { copper } conductors, 1911.  
 ..... { stranded } { ..... }

(c) Submarine signal transmission cables shall have  
 ..... (..) { solid } { copper } conductors No. ....  
 ..... (..) { stranded } { ..... }  
 ..... (..) B. & S. gauge { solid } { copper }  
 ..... { stranded } { ..... }  
 conductors, 1911.



525. *Wiring.*

(a) Wires in trunking, chases or conduits shall be laid loosely without stretching or crowding. 1911.

(b) Not more than two (2) wires shall be connected to one (1) binding post or terminal screw. 1911.

526. *Common return.*

(a) Reductions in size of common wire and connections to pole lines shall be made in junction boxes. 1911.

(b) Connections between branches and main common wires shall be made in junction boxes. 1911.

527. *Joints in wire.*

(a) Wires shall, as far as practicable, be continuous without joints or breaks; joints shall be made only on permission from the Engineer. 1911.

(b) In making joints, braid shall be pulled back one (1) inch from end of rubber on each side of splice, and rubber cut with knife held at an angle of approximately thirty (30) degrees with axis of wire, as one would sharpen a pencil. 1911.

(c) After removing rubber, wire shall be thoroughly cleaned, care being taken to prevent injury from small cuts or nicks. 1911.

(d) Wire, after being cleaned, shall be twisted together in the form of a regular line wire splice, turns being spaced approximately one-sixty-fourth (1/64) inch. 1911.

(e) Joints shall then be soldered by pouring on them, or dipping them into melted solder, a non-corrosive flux being used. After soldering, joints shall be covered with two (2) layers of rubber insulating tape between ends of braid, which tape shall be heated sufficiently to form a tight covering, but not enough to injure the quality of the material; insulating tape shall be in accordance with R. S. A. specification for "Rubber Insulating Tape." Two (2) layers of friction tape shall be applied over the rubber insulation and the ends of the braiding, and this tape shall then be thoroughly coated with black asphaltum paint. The friction tape shall be in accordance with R. S. A. specification for "Friction Tape." 1916.



## 262. Wiring.

- (a) Wires in trunking, chases or conduits shall be laid loosely without stretching or crowding.  
1911.
- (b) Not more than two (2) wires shall be connected to one (1) binding post or terminal screw.  
1911.

## 263. Joints.

- (a) Connections between branches and main conductors to pole lines shall be made in junction boxes.  
1911.
- (b) Connections between branches and main conductors shall be made in junction boxes.  
1911.

- (a) Wires shall, as far as practicable, be continuous without joints or breaks; joints shall be made only on permission from the Engineer.  
1911.

- (b) In making joints, braid shall be pulled back one (1) inch from the joint. The joint shall be made by cutting the rubber out with knife held at an angle of approximately thirty (30) degrees with axis of wire, as one would sharpen a pencil.  
1911.

- (c) After removing rubber, wire shall be thoroughly cleaned, care being taken to prevent injury from small cuts or nicks.  
1911.

- (d) Wire, after being cleaned, shall be twisted together in the form of a regular line wire splice, means being spaced approximately one-sixty-fourth (1/64) inch.  
1911.

- (e) Joints shall then be soldered by pouring on them or dipping them into melted solder, a non-corrosive flux being used. After soldering, joints shall be covered with two (2) layers of rubber insulating tape between ends of braid, which tape shall be heated sufficiently to form a tight covering, but not enough to injure the quality of the material; insulating tape shall be in accordance with R. S. A. specification for "Rubber Insulating Tape". Two (2) layers of friction tape shall be applied over the rubber insulation and the ends of the braid, and the tape shall then be thoroughly coated with black asphaltum paint. The friction tape shall be in accordance with R. S. A. specification for "Friction Tape".  
1911.

528. *Fuses.*

*Material.*

(a) Fuses shall be of the encloseded type, in accordance with R. S. A. drawing 1309. Fuse clips shall be mounted on an insulating base of fireproof material. 1915.

*Field work.*

(b) The necessary fuses to properly protect all apparatus and circuits shall be installed. 1911.

(c) Fuses outside of buildings shall be enclosed in weatherproof boxes. 1911.

(d) In the lighting circuits, a fuse shall be provided in the circuit to each signal lamp; in the circuit to each set of lamps on a mast; in each branch circuit leaving the mains, and in each set of mains leaving the switchboard.

530. *Tags.*

1911.

*Material.*

(a) Tags shall be made of vulcanized sheet fibre, not less than one-sixteenth (1/16) inch thick, firmly attached to the wire by the best quality yacht marline one-sixteenth (1/16) inch in diameter. 1911.

(b) The tag shall have a stamped imprint to show the function of the wire. 1911.

*Field work.*

(c) Wires shall be tagged at all junction boxes, switches, signals, relay boxes, arrester boxes, and at all line wire connections, unless otherwise specified. 1911.

532. *Petroleum asphaltum.*

*Material.*

(a) Petroleum asphaltum shall be in accordance with R. S. A. specification. 1916.

*Field work.*

(b) When specified, the wires in the trunking shall be loosely bound and shall be so laid in pitch as to be practically free of contact with all walls of the trunking. 1911.

(c) When petroleum asphaltum is used, terminal box bootlegs, trunking and bootleg terminals shall be in accordance with R. S. A. drawings 1154, 1155, 1156 and 1157. 1915.

BONDING

(Where propulsion, bonding is not required.)

540. *Bonding wires.*

*Material.*

(a) Bonding wires shall be in accordance with R. S. A. specification. 1916.

*Field work.*

(b) Number six (6) B. & S. gauge bare copper or copper-clad steel bonding wires shall be used. 1911.

(c) Bonding shall be in accordance with ..... drawing ..... Rail joints, except as below, shall



CONTROL APPARATUS

600. *Relays.*

Relays shall be in accordance with R. S. A. specification for "Alternating Current Relays." 1916.

610. *Circuit controllers.*

*Material.*

(a) Circuit controllers of substantial construction and positive in action shall be provided for track switches as specified and shall be so constructed that they can be maintained to make or break circuit when switch point shall be moved from the closed position three-sixteenths ( $3/16$ ) of an inch. 1911.

(b) Operating rods of switch circuit controllers shall be not less than three-fourths ( $3/4$ ) inch in diameter and adjustable, with a maximum distance of three (3) feet between supports. 1915.

(c) Circuit controllers for non-interlocked switches shall have two independent shunt connections from the circuit controllers to the track circuits of each track affected by the opening of switch and shall shunt tracks when switch point shall have been opened from the closed position three-sixteenths ( $3/16$ ) or ..... (..) of an inch. 1915.

(d) Lever and latch circuit controllers shall have ....  
..... (..) fingers ..... (..) normally open  
and ..... (..) closed contacts. 1911.

(e) Circuit controllers for switch points, movable point frogs or derails shall have ..... (..) fingers  
with ..... (..) normally open and ..... (..) closed contacts. 1911.

(f) Drawbridge circuit controllers shall have .....  
..... (..) fingers with ..... (..) normally  
open and ..... (..) closed contacts. 1911.

(g) Circuit controllers for mechanically interlocked signals shall have ..... (..) fingers with .....  
(..) open and ..... (..) closed contacts. 1911.



CONTROL APPARATUS

610. Circuit controllers shall be in accordance with M. S. A. specifications for lifting equipment. The design shall be in accordance with M. S. A. specifications for lifting equipment.

(a) Circuit controllers of switch gear shall be of the type which can be operated from the closed position without the need of an inch.

(b) Operating rods of switch gear shall be not less than three-fourths (3/4) inch in diameter and adjustable with a maximum distance of three (3) feet between supports.

(c) Circuit controllers for non-interlocked switches shall have two independent main connections from the circuit controllers to the track circuit of each track. The opening of switch and shall be such that when switch point shall have been opened from the closed position, the switch point shall have been opened from the closed position.

(d) Lever and latch circuit controllers shall have (1) fingers (2) normally open and (3) closed contacts.

(e) Circuit controllers for switch points movable point shall have (1) fingers (2) normally open and (3) closed contacts.

(f) Drawbridge circuit controllers shall have (1) fingers (2) normally open and (3) closed contacts.

(g) Circuit controllers for mechanically interlocked switches shall have (1) fingers (2) normally open and (3) closed contacts.

# SPECIFICATIONS AND REQUISITES OF APPARATUS AND MATERIAL FOR ALTERNATING CURRENT AUTO- MATIC BLOCK SIGNAL SYSTEM.

(On all railways except those using alternating current or direct  
current for propulsion.)

1912.

Revised 1916.

To be installed at.....  
on the ..... R.....

## INDEX.

	Section.
Air compressor .....	63
Air pipe line .....	98
Arresters, lightning .....	635
boxes .....	722
Bolts, signal foundation .....	271
Bonding .....	540 to 550
wires .....	540
Bootlegs .....	708
Boxes, junction .....	710
cable .....	718
lightning arrester .....	722
relay .....	720
Buildings .....	50 to 60
foundations .....	50
painting .....	840
Cable boxes .....	718
Cables for high tension circuits .....	524
for low voltage circuits .....	522
Channel pins .....	542
Circuits .....	500 to 520
electric lighting .....	506
practice .....	500
special .....	510
track .....	502
switchboard .....	501
Common return .....	526
Compressor, air .....	63
Concrete .....	280
Condensers .....	95
Conduits and supports .....	711
Control apparatus .....	610 to 650

# PRECIPITATIONS AND KNOCKOUTS OF APPARATUS AND MATERIAL FOR THE AUTOMATIC BLOCK SIGNAL SYSTEM.

(On all railways except those using automatic current or direct current for propulsion.)

Revised 1916.

THE

UNITED STATES DEPARTMENT OF COMMERCE

Section.

03	air pipe line
04	air pipe line
05	air pipe line
06	air pipe line
07	air pipe line
08	air pipe line
09	air pipe line
10	air pipe line
11	air pipe line
12	air pipe line
13	air pipe line
14	air pipe line
15	air pipe line
16	air pipe line
17	air pipe line
18	air pipe line
19	air pipe line
20	air pipe line
21	air pipe line
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94	air pipe line
95	air pipe line
96	air pipe line
97	air pipe line
98	air pipe line
99	air pipe line
100	air pipe line

2  
*Railway Signal Association.*

A.C. Automatic  
Block Signals.  
Steam Rys., Etc  
Index to  
Specifications.

	Section.
Controllers, circuit .....	610
Detail provisions .....	50 to 950
Distributing system .....	98 to 100
Electric lighting circuits .....	506
locks .....	615
Electrical requirements .....	30
Engine .....	61
Fibre, insulating .....	748
Foundation bolts, signal .....	271
Foundations .....	270
building .....	50
Fuses .....	528
General Provisions. (See unit specification.)	
Generator .....	65
Impedance bonds .....	543
Impedance coils .....	544
Indicators .....	625
Instrument shelter .....	720 to 735
Insulated rail joints .....	735
Insulating fibre .....	748
Insulations .....	735 to 800
pipe line .....	742
switch rod .....	738
tie plate .....	744
Iron work, painting .....	810
Joints in wire .....	527
rail, insulated .....	735
trunking .....	703
Junction boxes .....	710
terminals .....	928
Lamps .....	430
Lamp boxes .....	431
Lighting .....	54
Lightning arrester boxes .....	722
arresters .....	635
Line construction .....	714
Line supports .....	715
Locations, signal .....	435
Locks .....	925
electric .....	615
time .....	622
Motor .....	70
Motor generator .....	75
Number plates and numbers .....	926





	Section.
Painting .....	800 to 900
buildings .....	840
Paint .....	800
iron work .....	810
wood work .....	830
Petroleum asphaltum .....	532
Pins, channel .....	542
Pipe line insulation .....	742
Plant .....	60
Power house .....	52
Rail joints, insulated .....	735
Relay boxes .....	720
cases .....	721
Releases, hand .....	618
Roundels .....	425
Shelter, grid or unit .....	724
transformer .....	723
Signal locations .....	435
Signals .....	400 to 500
electric motor type .....	440
electro-pneumatic type .....	442
light type .....	443
solenoid type .....	441
Special circuits .....	510
items .....	900 to 950
Supply and distribution .....	76 and 77
auxiliary supply .....	77
main supply .....	76
Supports, high voltage cable .....	717
line .....	715
trunking .....	705
Switchboards .....	90
circuits .....	501
Switch indicators .....	625
rod insulations .....	738
Tags .....	530
Tie plate insulations .....	744
Track circuits .....	502
Transformers .....	80
shelter .....	723
Trunking .....	700 to 710
supports .....	705
joints .....	703
Type and assembly of signals .....	400



4  
*Railway Signal Association.*

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A.C. Automatic  
Block Signals.  
Steam Rys., Etc.  
Index to  
Specifications.

	Section.
Wire and wiring.....	520 to 540
bonding .....	540
joints .....	527
line for high voltage circuit.....	523
sizes .....	521
specifications .....	520
Wiring .....	525
Wood work, painting.....	830



Railway Signal Association.

Section	
240	Wiring
241	Machine
242	for high voltage circuit
243	
244	
245	
246	
247	
248	
249	
250	
251	
252	
253	
254	
255	
256	
257	
258	
259	
260	
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262	
263	
264	
265	
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267	
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SPECIFICATIONS AND REQUISITES OF APPARATUS AND  
MATERIAL FOR ALTERNATING CURRENT AUTO-  
MATIC BLOCK SIGNAL SYSTEM.

(On all railways, except those using direct or alternating current  
for propulsion.)

1912.

Revised 1916.

GENERAL PROVISIONS OF SPECIFICATIONS FOR  
SIGNAL INSTALLATIONS.

(See unit specification covering the text of these provisions indexed  
under Subdivision G.)

*Note.*—This unit specification has been adopted as of January 10,  
1917, to take the place of the "General Provisions," heretofore forming  
a part of these specifications. This sheet is numbered 1 to 5, in order  
to obviate the necessity of having the existing subject matter re-  
printed.



### GENERAL ELECTRICAL REQUIREMENTS.

30. *General electric requirements.*

(a) Electric apparatus shall withstand an insulation test at the place of manufacture of three thousand (3000) volts a.c. for one (1) minute. 1911.

(b) Magnets and solenoids shall be plainly marked with their resistance and the size of wire with which they are wound. 1911.

(c) Windings shall be treated in accordance with R. S. A. specifications for "Impregnation Treatment for Coils and Windings." 1916.

### DETAIL PROVISIONS.

#### BUILDINGS

50. *Foundations.*

(a) Foundations shall be provided by the ..... in accordance with specifications and drawings ....., dated ..... 1916.

(b) The foundation for interlocking station leadout supports shall be furnished in place by the ..... in accordance with R. S. A. drawings 1200, 1203, or 1217. 1916.

52. *Power house.*

Building shall be provided by the ..... in accordance with specifications and drawings ....., dated ..... 1916.

54. *Lighting.*

(a) The lighting for buildings shall be installed by ..... 1911.

(b) The type of fixtures, number, kind, size and switch control of electric lamps shall be in accordance with..... specifications and drawing ..... dated .....; lamps distributed as follows:

	Number.	Watts per Lamp.
Operating room	..... (..)	..... (..)
Tower room	..... (..)	..... (..)
Battery room	..... (..)	..... (..)
Generator room	..... (..)	..... (..)
Special	..... (..)	..... (..)

1916.

[illegible]



54. *Lighting.*—Continued.

(c) Fixtures for electric lighting shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

(d) Fixtures and accessories for electric lamps shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

POWER SUPPLY

60. *Plant.\**

(a) The power plant shall consist of .....  
 ..... 1916.

(b) .....  
 shall be furnished by ..... and installed  
 by ..... 1916.

(c) .....  
 shall be furnished by ..... and installed  
 by ..... 1916.

61. *Engine.*

(a) A ..... (..) cylinder ..... (..)  
 cycle { vertical } { steam } engine of ..... (..)  
           { horizontal } { air }  
           { turbine }

brake horse-power, manufactured by ....., installed by ....., the ..... shall be furnished on a ..... foundation, to be furnished in place by the ....., constructed in accordance with the standard specifications of the ..... and drawings of the Manufacturer of the engine numbers ..... , dated ..... 1916.

(b) Gasoline engines, fuel and water tanks shall conform to R. S. A. specifications. 1916.

(c) Engines shall be of such type as to be easily accessible for attention to bearings, adjusting and cleaning. 1916.

(d) Contractor shall furnish sufficient material for installation of muffler outside of building with as few turns and bends as practicable. 1916.

(e) A complete set of wrenches shall be furnished. 1911.

---

\*R. S. A. drawings 1388 and 1389 may be used as guides in determining the parts of each plant, which may then be specified in Section 60.

Lighting—Continued.

- (c) Fixtures for electric lighting shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.
- (d) Fixtures and accessories for electric lamps shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

THE SIGNAL

- (a) The power plant shall be of

SHOULD BE FURNISHED

- (b) The power plant shall be of the type and make specified by the Signal Association and the Signal Association shall be notified of the make and make of the power plant. 1916.
- (c) The power plant shall be of the type and make specified by the Signal Association and the Signal Association shall be notified of the make and make of the power plant. 1916.

- (d) The engine of the power plant shall be of the type and make specified by the Signal Association and the Signal Association shall be notified of the make and make of the power plant. 1916.

- (e) The engine of the power plant shall be of the type and make specified by the Signal Association and the Signal Association shall be notified of the make and make of the power plant. 1916.

- (f) The engine of the power plant shall be of the type and make specified by the Signal Association and the Signal Association shall be notified of the make and make of the power plant. 1916.

- (g) The engine of the power plant shall be of the type and make specified by the Signal Association and the Signal Association shall be notified of the make and make of the power plant. 1916.

- (h) The engine of the power plant shall be of the type and make specified by the Signal Association and the Signal Association shall be notified of the make and make of the power plant. 1916.

- (i) The engine of the power plant shall be of the type and make specified by the Signal Association and the Signal Association shall be notified of the make and make of the power plant. 1916.

- (j) The engine of the power plant shall be of the type and make specified by the Signal Association and the Signal Association shall be notified of the make and make of the power plant. 1916.

\* R. S. A. drawings 1388 and 1389 may be used as guides in determining the parts of each plant which may then be specified in Section 60.

61. *Engine.*—Continued.

(f) Exposed piping subject to excessive heat shall be protected with  $\left\{ \begin{array}{l} \text{asbestos} \\ \text{.....} \end{array} \right\}$  covering. 1916.

63. *Air compressor.*

A  $\left\{ \begin{array}{l} \text{one} \\ \text{two} \end{array} \right\}$  stage air compressor of ..... (..) indicated horsepower, capacity of ..... (..) cubic feet of free air per minute at ..... (..) feet elevation above sea level, and designed for air pressure of ..... (..) pounds, manufactured by ..... , installed by the ..... , shall be furnished on a ..... foundation, to be furnished in place by the ..... , constructed in accordance with the standard specifications of the ..... , and drawings of the Manufacturer. 1911.

65. *Generator.*

The electric generator shall be in accordance with R. S. A. specifications. 1916.

70. *Motor.*

The motor shall be ..... (..) horsepower, with a rated speed not to exceed ..... (..) r. p. m., if direct current, or one thousand eight hundred (1800) r. p. m., if alternating current, and shall have automatic regulation to within twenty (20) per cent., when operating on ..... (..) to ..... (..) volts d.c., or on ..... (..) to ..... (..) volts ..... (..) cycles ..... (..) phase a.c., shall be in accordance with R. S. A. specifications for "Electric Generators" regarding heating, sparking and insulation, and shall be furnished with a starting panel. 1916.

75. *Motor generator.*

Motor generator shall be direct connected, mounted on a cast iron sub-base and shall conform to the specifications for motors and generators (Sections 65 and 70). 1911.

(f) The speed of the motor shall be

indicated horsepower, capacity of ... cubic  
feet of free air per minute at ... level  
above sea level and ... for the ... of  
... shall be ...  
... to be furnished on a ...  
... in accordance with the ...  
... of the ...

The electric generator shall be in accordance with

#### Generator

The motor shall be ... horsepower with  
a rated speed not to exceed ... r.p.m.  
direct current or one thousand eight hundred (1800)  
r.p.m. If alternating current, and shall have automatic  
regulation to within twenty (20) per cent, when operating  
on ... to ... volts  
or on ... to ... volts  
... cycles ... phase and  
shall be in accordance with R. S. A. specifications for  
"Electric Generators" regarding heating, sparking and in-  
sulation, and shall be furnished with a starting hand.

#### Motor Generator

Motor generator shall be direct connected, mounted on  
a cast iron sub-base and shall conform to the specifications  
for motors and generators (Sections 63 and 70). 1911.

98. *Air pipe line.*—Continued.

(m) Each branch line must contain a combined brass cock and union at or near its connection with the main.

1911.

(n) The main air line must be in good surface and auxiliary tanks connected in line at the bottom of all slopes, and the air line shall be graded, so condensation will run into suitable drain tanks. Auxiliary tanks shall be connected in series with the main air line and be provided with by-pass of the same size as the main air line. Flanges, unions, gate valves, etc., shall be provided so that auxiliary tanks may be removed without interrupting the flow of air through the by-pass.

1915.

(o) The air line when placed above ground parallel to the track shall not be placed nearer than six (6) feet from the gauge side of nearest rail except by special permission.

1911.

(p) Local conditions shall determine the height of the main air line when above ground, but in all cases, the bottom of the pipe shall be not less than six (6) inches above the top of the ground, except by special permission.

1915.

(q) Stakes for supports shall be placed not more than ten (10) feet apart.

1911.

(r) Red lead, graphite or other equivalent protections for threads must be applied to the pipe threads and only after pipe connections have been started when pipe is coupled.

1915.

(s) Each length of pipe and the fittings must be free from dirt and scale before being coupled in the line, and care must be exercised that no dirt gets into the line at any time. All pipe lines must be blown out before being connected to any apparatus.

1911.

FOUNDATIONS

270. *Foundations.*

*Field work.*

(a) Foundations shall be rigid, level, and in good alignment.

1916.

(b) Foundations shall be set parallel to track, except as otherwise specified.

1911.

(c) Dimensions of concrete foundations shall be in accordance with the following R. S. A. drawings 1105, 1107 and 1108, or drawings which shall be submitted or approved by the Purchaser.

1916.

(d) Dimensions for concrete foundations are indicated for level and solid ground. The Purchaser will decide when deviations from specified sizes are necessary.

1916.



- (a) Foundations shall be rigid, level, and in good alignment.
- (b) Foundations shall be set parallel to track, except as otherwise specified.
- (c) Dimensions of concrete foundations shall be in accordance with the following R. & A. standards, and no variation or change of drawings shall be submitted or approved by the Purchaser.
- (d) Dimensions for concrete foundations are indicated for level and solid ground. The Purchaser will decide when deviations from specified sizes are necessary.

Field Work

- (a) Foundations shall be rigid, level, and in good alignment.
- (b) Foundations shall be set parallel to track, except as otherwise specified.
- (c) Dimensions of concrete foundations shall be in accordance with the following R. & A. standards, and no variation or change of drawings shall be submitted or approved by the Purchaser.
- (d) Dimensions for concrete foundations are indicated for level and solid ground. The Purchaser will decide when deviations from specified sizes are necessary.

- (e) Stakes for supports shall be placed not more than ten (10) feet apart.
- (f) Red lead or graphite or other equivalent protection for threads must be applied to the pipe threads and only after pipe connections have been started when pipe is coupled.
- (g) Each length of pipe and the fittings must be free from dirt and scale before being connected in the line, and care must be exercised that no dirt gets into the line at any time. All pipe lines must be blown out before being connected to any apparatus.

- (h) The air line when placed above ground shall be so placed that it shall not be placed lower than six (6) feet from the ground side of the track and except by special permission.
- (i) Local conditions shall determine the height of the main air line when above ground, but in all cases the bottom of the pipe shall be not less than six (6) inches above the top of the ground, except by special permission.

- (j) The main air line must be in good surface and auxiliary tanks connected in line at the bottom of all tanks, and the air line shall be gauged, so constructed with the into suitable drain tanks. Auxiliary tanks shall be connected in series with the main air line and be provided with bypass of the same and safety valve and air line changes, unions, gate valves, etc. shall be provided.
- (k) The flow of air through the bypass.

- (l) The main air line must be in good surface and auxiliary tanks connected in line at the bottom of all tanks, and the air line shall be gauged, so constructed with the into suitable drain tanks. Auxiliary tanks shall be connected in series with the main air line and be provided with bypass of the same and safety valve and air line changes, unions, gate valves, etc. shall be provided.
- (m) When water line
- (n) When water line

270. *Foundations.*—Continued.

(e) Concrete foundations shall stand until properly set before any apparatus is connected thereto or placed thereon. 1911.

(f) Foundations shall be so constructed that apparatus can be removed without disturbing them. 1911.

(g) Dimensions of concrete foundations for other than signal foundations shall be in accordance with ..... drawing ..... 1916.

271. *Signal foundation bolts.*

(a) Foundation bolts for ground masts shall be one (1) inch by thirty-six (36) inches. 1911.

(b) Foundation bolts for bracket signal posts shall be one and one-half (1½) inches by sixty (60) inches. 1915.

280. *Concrete.*

Concrete shall be in accordance with R. S. A. specifications. 1916.

SIGNALS

400. *Type and assembly.*

(a) Signals shall be of the semaphore or ..... type. Semaphore signals shall have an arm travel of ..... degrees in the ..... { right } { left } quadrant. 1916.

(b) The type of signals (as shown by the R. S. A. symbols) and location of signals shall be in accordance with ..... drawing ..... 1916.

(c) Signals and fittings shall be in accordance with R. S. A. drawings:

1026—Ladders.

1027—Ladders.

1028—Ladders for bracket posts and mechanical bracket masts.

1029—Ladder clamps and stays.

1032—Channel bracket posts.

1033—Mounting for bottom mast. Bracket post.

1034—Base for ground signal mast.

1035—Signal masts.

1036—Base for bridge and bracket masts.

1038—Base for pipe bracket post. Post shall be made of ..... inch and ..... inch steel pipe and water-tight joints.

1039—Pipe bracket post.

1040—Semaphore spectacle, design "A."

ons.—Continued.

- (c) Concrete foundations shall stand until properly set before any apparatus is connected thereto or placed thereon.
- (f) Foundations shall be so constructed that apparatus can be removed without disturbing them.
- (g) Dimensions of concrete foundations for other than signal foundations shall be in accordance with the following table:

Signal	Foundations
(a) Foundation bolts for ground mast shall be one inch by thirty-six (36) inches.	
(b) Foundation bolts for bracket signal posts shall be one and one-half (1½) inches by sixty (60) inches.	

Concrete

Concrete shall be in accordance with R. S. A. specifications.

Signals

Type and assembly.

- (a) Signals shall be of the semaphore or the following type and assembly:
- (b) The type of signals (as shown by the R. S. A. symbols) and location of signals shall be in accordance with the following table:
- (c) Signals and fittings shall be in accordance with the following table:

1004—Semaphore spectacle, design "A".	
1005—Pipe bracket post.	
1006—Steel pipe and water-tight joints.	
1007—Base for pipe bracket post. Post shall be made of steel pipe and water-tight joints.	
1008—Base for pipe bracket post.	
1009—Mounting for bottom mast. Bracket post.	
1010—Channel bracket post.	
1011—Ladder clamps and stays.	
1012—Ladders for bracket posts and mechanical	
1013—Ladders.	

400. *Type and assembly.* (c)—Continued.

1041—Semaphore spectacle, design "B."

Lower quadrant signals shall be in accordance with ..... drawing .....  
 ..... Light type signals shall be in accordance with ..... drawing .....  
 .....

1049—Lamp bracket.

1050—Pinnacle.

1052—Ladder foundation.

1059—Clamp for base of ground signal masts.

\*1065—Blades for upper quadrant signals.

1070—Binding post.

1083—"U" bolt and clamp.

1090—Filler block to limit travel of signal arms.

1091—Filler block to limit travel of signal arms.

1093—Diagram of spectacle clearance.

1178—Clamps for base of bridge and bracket masts.

1179—Hand-rail for bracket post.

1235—Semaphore spectacle, design "C."

425. *Roundels.*

Roundels shall be in accordance with R. S. A. specification and shall be supplied as follows:

	Color	Dia. Inches	
Stop .....			(..)
Caution .....			(..)
Proceed .....			(..)
Back light .....			(..)

1916.

430. *Lamps.*

(a) Lamps shall be { oil. }  
 { convertible. } 1911.

(b) Oil lamps shall be in accordance with R. S. A. drawing 1100. 1916.

(c) Convertible lamps shall be equipped with .....  
 ..... (..) incandescent lamps and marine receptacles,  
 in accordance with ..... drawing .....  
 and with oil founts and burners. 1911.

\* Blades (wood) for lower quadrant signals shall be in accordance with ..... drawing .....

High blades shall be made of { enameled steel. }  
 { well seasoned ..... }  
 Enameled steel blades shall be in accordance with .....  
 ..... drawing ..... 1916.

Lower quadrant signals shall be in accordance with the following drawing.

- 1050—Circuit.
- 1051—Ladder foundation.
- 1052—Clamp for base of ground signal mast.
- 1053—Blades for upper quadrant signal.
- 1054—Blade for lower quadrant signal.
- 1055—UT bolt and clamp.
- 1056—Blade for lower quadrant of signal mast.
- 1057—Blade for upper quadrant of signal mast.
- 1058—Diagram of spectacle clearance.
- 1059—Diagram for base of bridge and ladder mast.
- 1060—Diagram for ladder mast.

Signals shall be in accordance with R. S. A. specifications and shall be supplied as follows:

Signal	Location	Notes
Stop	.....	.....
.....	.....	.....
.....	.....	.....

- (a) Lamps shall be (i) oil, (ii) convertible.
- (b) Oil lamps shall be in accordance with R. S. A. drawing 1016.
- (c) Convertible lamps shall be equipped with (i) incandescent lamps and marine receptacles in accordance with drawing 1017, and with oil lamps and burner in accordance with drawing 1018.

\*Blades (wood) for lower quadrant signals shall be in accordance with drawing 1019. High blades shall be made of (i) enameled steel, (ii) well seasoned steel. Steel blades shall be in accordance with drawing 1020.



430. *Lamps.—Continued.*

(d) ..... (..) extra incandescent lamps shall  
be furnished. 1911.

431. *Lamp boxes.*

Lamp boxes shall be in accordance with .....  
drawing ..... 1911.

435. *Signal locations.*

(a) Signal masts shall be on the right of the track gov-  
erned and adjacent thereto, where practicable. 1911.

(b) Signal arms on tangent shall be at right angles to  
track governed when sufficient approach is on tangent. On  
curves signal arms shall be at right angles to imaginary  
line drawn from the signal to the point where the best  
view can be obtained by the engineman, as decided by the  
Purchaser. 1911.

(c) Signals placed between tracks on tangent shall be  
set so that the center of mast shall be midway between  
tracks. Signals placed between tracks on curves shall be  
set off the center line between tracks and towards the  
center of the curve two and one-half ( $2\frac{1}{2}$ ) inches for  
each one (1) inch super-elevation. 1911.

(d) Before any signals are erected, the Purchaser shall,  
in the presence of the Contractor's foreman (or other rep-  
resentative), locate each signal. 1911.

(e) Outside of tracks, ground masts shall be placed  
..... (..) feet and bracket posts .....  
(..) feet from nearest rail. 1911.

(f) Bridge masts shall be located on .....  
chord of bridge. 1911.

(g) Base of high signals shall be ..... (..) inches below base of rail. 1911.

440. *Electric motor type.*

(a) Motor shall operate arm through [ninety degrees  
(90)] in [ten (10)] seconds at [one hundred ten (110)]  
volts normal load, voltage and frequency. 1913.

(b) Motor shall be capable of starting the semaphore  
from any point in its arc with [thirty-three (33)] per cent.  
increase in normal torque at normal voltage and frequency.  
1913.

(c) Motor shall be capable of starting the semaphore  
from a standstill at any point in its arc at [ninety (90)]  
volts with normal torque and frequency, the normal volt-  
age of signal being [one hundred ten (110)]. 1913.



524. *Cables for high voltage circuits. (a)—Continued.*

B. & S. gauge  $\left\{ \begin{array}{l} \text{solid} \\ \text{stranded} \end{array} \right\} \left\{ \begin{array}{l} \text{copper} \\ \text{.....} \end{array} \right\} \text{conductors.}$

1911.

(b) Underground signal transmission cables shall have

..... (..)  $\left\{ \begin{array}{l} \text{solid} \\ \text{stranded} \end{array} \right\} \left\{ \begin{array}{l} \text{copper} \\ \text{.....} \end{array} \right\} \text{conductors No.....}$

..... (..) B. & S. gauge and ..... (..) No. .... (..)

B. & S. gauge  $\left\{ \begin{array}{l} \text{solid} \\ \text{stranded} \end{array} \right\} \left\{ \begin{array}{l} \text{copper} \\ \text{.....} \end{array} \right\} \text{conductors.}$

1911.

(c) Submarine signal transmission cables shall have

..... (..)  $\left\{ \begin{array}{l} \text{solid} \\ \text{stranded} \end{array} \right\} \left\{ \begin{array}{l} \text{copper} \\ \text{.....} \end{array} \right\} \text{conductors No.....}$

..... (..) B. & S. gauge  $\left\{ \begin{array}{l} \text{solid} \\ \text{stranded} \end{array} \right\} \left\{ \begin{array}{l} \text{copper} \\ \text{.....} \end{array} \right\}$

conductors.

1911.

525. *Wiring.*

(a) Wires in trunking, chases or conduits shall be laid loosely without stretching or crowding. 1911.

(b) Not more than two (2) wires shall be connected to one (1) binding post or terminal screw. 1911.

526. *Common return.*

(a) Reductions in size of common wire and connections to pole lines shall be made in junction boxes. 1911.

(b) Connections between branches and main common wires shall be made in junction boxes. 1911.

527. *Joints in wire.*

(a) Wires shall, as far as practicable, be continuous without joints or breaks; joints shall be made only on permission from the Engineer. 1911.

(b) In making joints, braid shall be pulled back one (1) inch from end of rubber on each side of splice, and rubber cut with knife held at an angle of approximately thirty (30) degrees with axis of wire, as one would sharpen a pencil. 1911.

(c) After removing rubber, wire shall be thoroughly cleaned, care being taken to prevent injury from small cuts or nicks. 1911.

(d) Wire, after being cleaned, shall be twisted together in the form of a regular line wire splice, turns being spaced approximately one-sixty-fourth (1/64) inch. 1911.

1911.

(e) Joints shall then be soldered by pouring on them, or dipping them into melted solder, a non-corrosive flux being used. After soldering, joints shall be covered with two

Wiring for high voltage circuits. (a)—Continued.

B. & S. gauge { solid { copper {  
 stranded { conductors {

(b) Underground signal transmission cables shall have

B. & S. gauge { solid { copper {  
 stranded { conductors {  
 B. & S. gauge { solid { copper {  
 stranded { conductors {

(c) Submarine signal transmission cables shall have

B. & S. gauge { solid { copper {  
 stranded { conductors {

(a) Wires in running spaces or conduits shall be laid

loosely without stretching or crowding.

(b) Two more than two (2) wires shall be connected to

one (1) binding post or terminal screw.

(a) Reduction in size of common wire and connection

to pole line shall be made in junction boxes.

(b) Connections between branch and main common

wires shall be made in junction boxes.

(a) Wires shall be laid as practicable, be continuous

without joints or broken joints shall be made only on per-

mission from the Engineer.

(b) In making joints, wires shall be pulled back one (1)

inch from end of ribbon on each side of splice and under

cut with knife held at an angle of approximately thirty

(30) degrees with axis of wire as one would shape a

encil.

(c) After removing rubber wire shall be thoroughly

cleaned, care being taken to prevent injury from small cuts

or nicks.

(d) Wires, after being cleaned, shall be twisted together

in the form of a regular line wire splice turns being spaced

(e) Joints shall then be soldered by pouring on them a

dipping them into melted solder a non-corrosive flux being

used. After soldering joints shall be covered with two



527. *Joints in wire.* (e)—Continued.

(2) layers of rubber insulating tape between ends of braid, which tape shall be heated sufficiently to form a tight covering, but not enough to injure the quality of the material; insulating tape shall be in accordance with R. S. A. specification for "Rubber Insulating Tape." Two (2) layers of friction tape shall be applied over the rubber insulation and the ends of the braiding, and this tape shall then be thoroughly coated with black asphaltum paint. The friction tape shall be in accordance with R. S. A. specification for "Friction Tape." 1916.

528. *Fuses.*

*Material.*

(a) Fuses shall be of the encloseded type, in accordance with R. S. A. drawing 1309. Fuse clips shall be mounted on an insulating base of fireproof material. 1915.

*Field work.*

(b) The necessary fuses to properly protect all apparatus and circuits shall be installed. 1911.

(c) Fuses outside of buildings shall be enclosed in weatherproof boxes. 1911.

(d) In the lighting circuits, a fuse shall be provided in the circuit to each signal lamp; in the circuit to each set of lamps on a mast; in each branch circuit leaving the mains, and in each set of mains leaving the switchboard.

530. *Tags.*

1911.

*Material.*

(a) Tags shall be made of vulcanized sheet fibre, not less than one-sixteenth (1/16) inch thick, firmly attached to the wire by the best quality yacht marline one-sixteenth (1/16) inch in diameter. 1911.

(b) The tag shall have a stamped imprint to show the function of the wire. 1911.

*Field work.*

(c) Wires shall be tagged at all junction boxes, switches, signals, relay boxes, arrester boxes, and at all line wire connections, unless otherwise specified. 1911.

532. *Petroleum asphaltum.*

*Material.*

(a) Petroleum asphaltum shall be in accordance with R. S. A. specifications. 1916.

*Field work.*

(b) When specified, the wires in the trunking shall be loosely bound and shall be so laid in pitch as to be practically free of contact with all walls of the trunking. 1911.

(c) When petroleum asphaltum is used, terminal box bootlegs, trunking and bootleg terminals shall be in accordance with R. S. A. drawings 1154, 1155, 1156 and 1157.

1915.



(e)---Continued.

(2) Layers of rubber insulating tape between ends of wires which tape shall be heated sufficiently to form a tight covering, but not enough to impair the quality of the material, insulating tape shall be in accordance with R. & A. specification for "Rubber Insulating Tape". Two (2) layers of friction tape shall be applied over the rubber insulation and the ends of the ~~insulation~~ this tape shall then be thoroughly coated with ~~insulating~~ asphaltum paint. The friction tape shall be in accordance with R. & A. specification for "Friction Tape".

1915. Fuses.

Material.

(a) Fuses shall be of the enclosed type, in accordance with R. & A. drawing 1901. Fuse clips shall be mounted on an insulating base of fireproof material.

1915.

Field work.

(b) The necessary fuses to properly protect all apparatus and circuits shall be installed.

(c) Fuses outside of buildings shall be enclosed in weatherproof boxes.

1911.

(d) In the lighting circuit, a fuse shall be provided in the circuit to each signal lamp; in the circuit to each set of lamps on a track; in each branch circuit between the main and in each set of boxes serving the switchboard.

1917. Tags.

Material.

(a) Tags shall be made of vulcanized sheet rubber, not less than one-eighth (1/8) inch thick, and not extending to the ends of the best quality gauge number one-eighth (1/8) inch in diameter.

1911.

(b) The tag shall have a stamped imprint to show the location of the wire.

Field work.

(c) Wires shall be tagged at all junction boxes, switches, signal, relay boxes, meter boxes, and at all line wire connections unless otherwise specified.

12. Petroleum asphaltum.

Material.

(a) Petroleum asphaltum shall be in accordance with R. & A. specifications.

1910.

Field work.

(b) When specified, the wires in the trunking shall be loosely bound and shall be so laid in ducts as to remain easily free of contact with all walls of the trunking.

(c) When petroleum asphaltum is used, terminal box, bootlegs, trunking and hooking terminals shall be in accordance with R. & A. specifications.

BONDING

(Where propulsion, bonding is not required.)

540. *Bonding wires.*

*Material.*

(a) Bonding wires shall be in accordance with R. S. A. specification. 1916.

*Field work.*

(b) Number six (6) B. & S. gauge bare copper or copper-clad steel bonding wires shall be used. 1911.

(c) Bonding shall be in accordance with ..... drawing ..... Rail joints, except as below, shall be bonded with two (2) number six (6) B. & S. gauge bonding wires. Where joints are located in platforms or road crossings, whether of plank, brick, or ballast filling, four (4) wires must be used at each joint, two (2) being placed on either side of rail and outside of angle bar. 1911.

(d) Frogs shall be bonded in the same manner as the rail joints and shall be so connected, that the continuity of the track circuit will be broken when they are removed from the track. 1911.

542. *Channel pins.*

*Material.*

(a) Channel pins shall be in accordance with R. S. A. specifications. Single channel pins shall be in accordance with R. S. A. drawing 1086. 1916.

*Field work.*

(b) Each bond wire shall be fastened at each end into the web of the rail by a channel pin. 1911.

(c) Channel pins shall be driven the same day that holes are drilled. 1911.

IMPEDANCE COILS

544. *Impedance coils.*

Impedance coils shall be in accordance with ..... specifications. 1913.

CONTROL APPARATUS

600. *Relays.*

Relays shall be in accordance with R. S. A. specification for "Alternating Current Relays." 1916.



## SPECIFICATIONS FOR DIRECT CURRENT AUTOMATIC BLOCK SIGNALS—LOW VOLTAGE.

1916.

To be installed at .....  
 on the ..... R.....

### INDEX.

	Section.
Annunciators (See control apparatus).....	630
Arresters, lightning (See control apparatus).....	635
Assembly, type and (See signals).....	400
Batteries .....	550 to 551
batteries .....	551
type of battery .....	550
storage (See power supply).....	85
Battery chutes (See instrument and battery shelters).....	725
Battery wells and boxes (See instrument and battery shelters) ..	728
Bolts, foundation (See foundations).....	271
Bonding .....	540 to 542
channel pins .....	542
wires .....	540
Bootlegs (See trunking, conduit and supports).....	708
Boxes, cable (See trunking, conduit and supports).....	718
Boxes, battery wells and (See instrument and battery shelters) ..	728
Boxes, lightning arrester (See instrument and battery shelters) ..	722
Boxes, relay (See instrument and battery shelters).....	720
Buildings .....	50 to 60
foundations .....	50
interlocking station .....	51
lighting .....	54
power house .....	52
Cable boxes (See trunking, conduit and supports).....	718
Cables, wires and (See wires and wiring).....	520
Cables for low voltage (See wires and wiring).....	522
Cases, relay (See instrument and battery shelters).....	721
Channel pins (See bonding).....	542
Chutes, battery (See instrument and battery shelters).....	725
Circuit controllers (See control apparatus).....	610
Circuits .....	500 to 510
practice .....	500
track .....	502
electric lighting .....	506
special .....	510





	Section.
Concrete (See foundations).....	280
Conduits (See trunking, conduits and supports).....	711
Connections, mechanical .....	301
Control apparatus .....	600 to 635
relay .....	600
circuit controllers .....	610
electric locks .....	615
releases .....	618
indicators .....	625
annunciators .....	630
lightning arresters .....	635
Electric lighting (See circuits).....	506
Electric locks (See control apparatus).....	615
Electric motor type (See signals).....	440
Engine (See power supply).....	61
Fibre, insulating (See insulations).....	748
Foundations .....	270 to 280
concrete .....	280
foundations .....	270
foundation bolts .....	271
Foundations (See buildings).....	50
Gauge plate insulations (See insulations).....	744
Generators (See power supply).....	65
House, power (See buildings).....	52
Indicators (See control apparatus).....	625
Interlocking station (See buildings).....	51
Instrument and battery shelters.....	720 to 728
battery chutes .....	725
battery wells and boxes.....	728
lightning arrester boxes .....	722
relay boxes .....	720
relay cases .....	721
Insulations .....	735 to 748
gauge plate insulations .....	744
insulated rail joints.....	735
insulating fibre .....	748
pipe line insulations.....	742
switch rod insulations.....	738
Joints, insulated rail (See insulations).....	735
Joints in trunking (See trunking, conduit and supports).....	703
Joints in wire (See wires and wiring).....	527
Junction boxes (See trunking, conduit and supports).....	710
Lamps (See signals) .....	430



	Section.
Lighting (See buildings) .....	54
Lightning arresters (See control apparatus).....	635
Lightning arrester boxes (See instrument and battery shelters) ..	722
Line construction (See trunking, conduit and supports).....	714
Line supports (See trunking, conduit and supports).....	715
Locations (See signals).....	435
Locks .....	925
Locks, electric (See control apparatus).....	615
Mechanical connections .....	301
Mercury arc rectifiers (See power supply).....	81
Motors (See power supply).....	70
Motor generators (See power supply).....	75
Number plates and numbers.....	926
Paint .....	800
Petroleum asphaltum .....	532
Pipe line insulations (See insulations).....	742
Plant (See power supply).....	60
Power house (See buildings).....	52
Power supply .....	60 to 90
engine .....	61
generators .....	65
mercury arc rectifiers .....	81
motors .....	70
motor generator .....	75
plant .....	60
storage batteries .....	85
switchboards and equipment.....	90
transformers .....	80
Practice (See circuits).....	500
Rectifier, mercury arc (See power supply).....	81
Relays (See control apparatus).....	600
Relay boxes (See instrument and battery shelters).....	720
Relay cases (See instrument and battery shelters).....	721
Releases (See control apparatus).....	618
Roundels (See signals).....	425
Signals .....	400 to 440
electric motor type .....	440
lamps .....	430
locations .....	435
roundels .....	425
type and assembly.....	400
Size (See wires and cables).....	521
Special (See circuits).....	510
Special items .....	900
Station, interlocking (See buildings).....	51



	Section.
Storage batteries (See power supply).....	85
Switch rod insulations (See insulations).....	738
Switchboards and equipment (See power supply).....	90
Tagging (See wires and wiring).....	530
Track (See circuits).....	502
Transformers (See power supply).....	80
Trunking, conduit and support.....	700 to 718
bootlegs .....	708
cable boxes .....	718
conduits .....	711
joints in .....	703
junction boxes .....	710
line construction .....	714
line supports .....	715
supports .....	705
trunking .....	700
Type (see batteries) .....	550
Type and assembly (See signals).....	400
Type, electric motor (See signals).....	440
Wells, battery and boxes (See instrument and battery shelters). ..	728
Wires (See bonding) .....	540
Wires and wiring .....	520 to 530
cables for low voltage circuits.....	522
joints in wire.....	527
size .....	521
tagging .....	530
wires and cables.....	520





SPECIFICATIONS FOR DIRECT CURRENT AUTOMATIC  
BLOCK SIGNALS—LOW VOLTAGE.

1916.

GENERAL ELECTRICAL REQUIREMENTS.

DETAIL PROVISIONS.

BUILDINGS

50. *Foundations.*

(a) Foundations shall be provided by the .....  
in accordance with specifications and drawings .....  
..... dated ..... 1916.

(b) The foundation for interlocking station leadout  
supports shall be furnished in place by the ..... in  
accordance with R. S. A. drawings 1200, 1203, or 1217.  
1916.

51. *Interlocking station.*

Building shall be provided by the ..... in ac-  
cordance with specifications and drawings .....  
dated ..... 1916.

52. *Power house.*

Building shall be provided by the ..... in ac-  
cordance with specifications and drawings .....  
dated ..... 1916.

54. *Lighting.*

(a) The lighting for buildings shall be installed by  
..... 1911.

(b) The type of fixtures, number, kind, size and switch

REVERSE SIGNALS - LOW VOLTAGE  
AUTOMATIC

# GENERAL ELECTRICAL REQUIREMENTS

REQUIREMENTS  
FOR THE  
SIGNALS

FOUNDATION

... shall be provided by the ...  
... accordance with specifications and drawings ...  
(a) The foundation for interlocking station located  
... shall be provided in place by the ...  
... accordance with R. 2.11 drawings 1200, 1201, or 1202.

Interlocking station  
... shall be provided by the ...  
... accordance with specifications and drawings ...  
dated ...

Power house  
... shall be provided by the ...  
... accordance with specifications and drawings ...  
dated ...

(a) The lighting for buildings shall be installed by ...

54. *Lighting.* (b)—Continued.

control of electric lamps shall be in accordance with .....  
 ..... specifications and drawing .....  
 dated .....; lamps distributed as follows:

	Number.	Watts per Lamp.
Operating room	..... (..)	..... (..)
Tower room	..... (..)	..... (..)
Battery room	..... (..)	..... (..)
Generator room	..... (..)	..... (..)
Special	..... (..)	..... (..)

1916.

(c) Fixtures for electric lighting shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

(d) Fixtures and accessories for electric lamps shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

POWER SUPPLY

60. *Plant.\**

(a) The power plant shall consist of .....  
 ..... 1916.

(b) .....  
 shall be furnished by ..... and installed  
 by ..... 1916.

(c) .....  
 shall be furnished by ..... and installed  
 by ..... 1916.

61. *Engine.*

(a) A ..... (..) cylinder ..... (..)  
 cycle { vertical  
       horizontal } { steam } engine of ..... (..)  
           turbine     { air     }  
 brake horse-power, manufactured by ....., in-  
 stalled by ....., the ..... shall be fur-  
 nished on a ..... foundation, to be furnished in  
 place by the ....., constructed in accordance  
 with the standard specifications of the ..... and  
 drawings of the Manufacturer of the engine numbers  
 ....., dated ..... 1916.

---

\*R. S. A. drawings 1388 and 1389 may be used as guides in determining the parts of each plant, which may then be specified in Section 60.





61. *Engine.*—Continued.

(b) Gasoline engines, fuel and water tanks shall conform to R. S. A. specifications. 1916.

(c) Engines shall be of such type as to be easily accessible for attention to bearings, adjusting and cleaning. 1916.

(d) Contractor shall furnish sufficient material for installation of muffler outside of building with as few turns and bends as practicable. 1916.

(e) A complete set of wrenches shall be furnished. 1911.

(f) Exposed piping subject to excessive heat shall be protected with { asbestos } covering. 1916.

65. *Generators.*

Electric generators shall be in accordance with R. S. A. specifications. 1916.

70. *Motors.*

Motors shall be ..... (..) horsepower with a rated speed not to exceed ..... (..) r. p. m., if direct current, or one thousand eight hundred (1,800) r. p. m. if alternating current, and shall have automatic regulation to within ..... (..) per cent. when operating on ..... (..) to ..... (..) volts d.c., or on ..... (..) to ..... (..) volts ..... (..) cycles ..... phase a.c. shall be in accordance with R. S. A. specifications regarding heating, sparking and insulation, and shall be furnished with starting panels. 1916.

75. *Motor generators.*

Motor generators shall be ..... connected, mounted on cast iron sub-bases or of unit frame construction, and shall be in accordance with the specifications for "Motors and Generators" (Sections 65 and 70).

1916.

80. *Transformers.*

Transformers shall conform to { R. S. A. } specifications. 1916.

81. *Mercury arc rectifier.*

Mercury arc rectifier shall conform to { R. S. A. drawing 1242 } and shall be of ..... (..) d.c. ampere capacity, with d.c. voltage regulation between ..... (..) and ..... (..) volts.



### 85. Storage batteries.

(b) Foundations shall be set parallel to track, except as otherwise specified.



(c) Dimensions of concrete foundations shall be in accordance with the following R. S. A. drawings: 1105, 1107 and 1108; or drawings which shall be submitted or approved by the Purchaser. 1916.

(e) Concrete foundations shall stand until properly set before any apparatus is connected thereto or placed thereon.

(g) Dimensions of concrete foundations for other than signal foundations shall be in accordance with ..... drawing ..... 1916.

(a) Foundation bolts for ground masts shall be in accordance with R. S. A. drawing 1107 (Detail 11071).

(b) Foundation bolts for bracket post shall be in accordance with R. S. A. drawing 1105 or 1108 (Detail 11051 or 11081). 1916.

Concrete shall be in accordance with R. S. A. specifications. 1916.

Mechanical connections shall be in accordance with R. S. A. specifications. 1916.

(a) Signals shall be of semaphore or ..... type. Semaphore signals shall have an arm travel of ..... degrees in the .....  $\left\{ \begin{array}{l} \text{right} \\ \text{left} \end{array} \right\}$  quadrant. 1916.



Continued.

(c) Dimensions of concrete foundations shall be in accordance with the following R. S. A. drawings: (Detail 1001) and (Detail 1002) or drawings which shall be submitted or approved by the Purchaser.

(d) Dimensions for concrete foundations are indicated for level and solid ground. The Purchaser will advise when deviations from specified sizes are necessary.

(e) Concrete foundations shall be constructed so as to be below any apparatus connected therewith.

(f) Foundations shall be so constructed that apparatus can be removed without disturbing them.

(g) Dimensions of concrete foundations for other than signal foundations shall be in accordance with the following drawings: (Detail 1003) and (Detail 1004).

(a) Foundation pits for ground wires shall be in accordance with R. S. A. drawing: (Detail 1005).

(b) Foundation pits for bracket post shall be in accordance with R. S. A. drawing: (Detail 1006) or (Detail 1007).

Concrete shall be in accordance with R. S. A. specifications.

Reinforcement shall be in accordance with R. S. A. specifications.

Signal Type and assembly.

(a) Signals shall be of standard type.

Signal lights shall have an arc of light of 180 degrees in the horizontal plane.

(b) The type of signals (as shown by the R. S. A. symbols) and location of signals shall be in accordance with ..... drawing ..... 1916.

1026—Ladders.  
1027—Ladders.  
1028—Ladders for bracket posts and mechanical bracket masts.  
1029—Ladder clamps and stays.  
1032—Channel bracket posts.  
1033—Mounting for bottom mast. Bracket post.  
1034—Base for ground signal mast.  
1035—Signal masts.  
1036—Base for bridge and bracket masts.  
1038—Base for pipe bracket post. Post shall be made of ..... inch and ..... inch steel pipe and water-tight joints.

1235—Semaphore spectacle, design "C."

High blades shall be made of { enameled steel.  
  { well seasoned ..... }  
Enameled steel blades shall be in accordance with .....  
..... drawing ..... 1916.



425. *Roundels.*

(a) Roundels shall be in accordance with R. S. A. specifications and shall be furnished as follows:

	Color.	Diameter. Inches.	
Stop	.....	.....	(..)
Caution	.....	.....	(..)
Proceed	.....	.....	(..)
Back light	.....	.....	(..)
			1916.

(b) Roundels shall be securely fastened in spectacles in a manner satisfactory to the Purchaser. 1916.

430. *Lamps.*

(a) Lamps shall be  $\left\{ \begin{array}{l} \text{oil.} \\ \text{electric.} \\ \text{convertible.} \\ \text{gas.} \end{array} \right\}$  1916.

(b) Oil lamps shall be in accordance with R. S. A. drawings 1100 and 1101. 1915.

(c) Electric lamps shall be equipped with .....  
 (..) incandescent lamps and shall be in accordance with .....  
 ..... drawing ..... 1916.

(d) Convertible lamps shall be equipped with .....  
 ..... (..) incandescent lamps with long time oil founts  
 and burners, and shall be in accordance with .....  
 drawing ..... 1916.

(e) Incandescent electric lamps shall be of .....  
 watts and ..... volts and in accordance with R. S.  
 A. drawing 1329. 1916.

(f) ..... (..) extra incandescent lamps shall  
 be furnished. 1916.

435. *Locations.*

*Field work.*

(a) Signals shall be located preferably over or upon the right of and adjoining the track to which they refer. 1916.

(b) Signal arms on tangent shall be at right angles to track governed when sufficient approach is on tangent. On curves signal arms shall be at right angles to imaginary line drawn from signal to the point where the best view can be obtained by the engineman, as decided by the Purchaser. 1911.

Handbook.  
(a) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:

- Director  
Step  
Condition  
Process  
Heat light

(b) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:

- (c) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:

(d) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:

(e) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:

(f) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:

(g) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:

(h) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:

(i) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:

(j) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:

(k) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:

(l) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:

(m) Handbook shall be in accordance with R. S. A.  
specifications and shall be in accordance with the following:



435. *Locations.—Continued.*

(c) Before any signals are erected, the Purchaser shall in the presence of the Contractor's Representative locate each signal. 1916.

(d) Outside of tracks, ground masts shall be placed ... .. (..) feet and bracket posts ... .. (..) feet from nearest rail. 1911.

(e) Where signals are located between tracks the center of signal mast shall not be less than ... .. (..) feet from center of either track. Signals located between tracks on curves, where the track centers are less than ... .. (..) feet, shall be set off the center line between tracks and toward the center of curves two and one-half ( $2\frac{1}{2}$ ) inches for each one (1) inch of superelevation of outer rail in curve. 1916.

(f) Bridge masts shall be located on ... .. chord of bridge. 1911.

(g) Base of high ground signals shall be level with top of rail unless otherwise specified. 1916.

440. *Electric motor type.*

Signals shall be of the electric motor type, operating mechanism located at ... .. and shall be in accordance with R. S. A. specifications. 1916.

CIRCUITS

500. *Practice.*

Circuits shall be in accordance with the Purchaser's recommended practice unless otherwise specified. 1916.

502. *Track circuits.*

(a) Contractor shall furnish ... .. track circuits, as shown on Purchaser's drawing ... .. dated ... .. 1916.

(b) Track circuits shall be continuous on all main tracks and extend the full length of crossovers and to the fouling point of turn-outs. Dead sections greater than ... .. (..) feet in length will not be permitted. 1915.

506. *Electric lighting circuits.*

(a) Circuits for electric lights shall be in accordance with plan submitted or approved by Purchaser. 1915.

(b) The maximum allowable drop in potential on electric lighting circuits from switchboard to any lamp shall be ten (10) per cent. 1911.

(c) A separate fuse shall be installed in each lamp circuit. 1916.



510. *Special circuits.*

The Purchaser will here indicate in full detail all special circuit requirements.

.....  
 .....  
 1911.

WIRES AND WIRING

520. *Wires and cables.*

Wires and cables shall be in accordance with R. S. A. specifications. 1916.

521. *Size.*

(a) Wires shall be of sufficient size to permit operation of signal mechanism in accordance with R. S. A. specifications. 1916.

(b) Single solid conductor rubber covered wire smaller than number fourteen (14) B. & S. gauge shall not be used. 1916.

(c) In main line cable work spare wires up to twenty-five (25) per cent. and in branch cables up to ten (10) per cent. of the number in use shall be provided as specified. When spare wires are required in other than cable work the number and size shall be specified. Spare wires are not required from pole lines to cable posts. 1916.

(d) Numbers and sizes of track circuit connections shall be as follows:

	Number of Conductors	B. & S. Gauge
1. Track Battery to Rail	.....one (1)	.....(..)
2. Relay to Rail	.....one (1)	.....(..)
3. Fouling Shunt Connections	.....two (2)	.....(..)
4. Switch Circuit Controller Connections	.....two (2)	.....(..)
		1916.

(e) Wires connected to track shall be rubber-covered soft-drawn copper. 1915.

(f) Number fourteen (14) or .....(..) B. & S. gauge wire shall be used for all connections from instrument to pole line or cable, including common. 1916.

(g) Number nine (9) or .....(..) B. & S. gauge wire shall be used for connections of motor to battery. 1916.

The Purchaser will have indicated in full detail all special

1917

WIRES AND WIRING

Wires and cables

Wires and cables shall be in accordance with R. S. A. specifications.

SHOULD BE SPECIFIED

(a) Wires shall be of sufficient size to permit operation of signal mechanism in accordance with R. S. A. specifications.

(b) Single solid conductor rubber covered wire shall be number fourteen (14) B. & S. gauge and not be less than number sixteen (16) B. & S. gauge.

(c) In main line cable work spare wires up to twenty-five (25) per cent. and in branch cables up to ten (10) per cent. of the number in use shall be provided as specified. When spare wires are required in other than cable work the number and size shall be specified. Spare wires are not required from pole lines to cable posts.

(d) Numbers and sizes of track circuit connections shall be as follows:

Switch Circuit Controller Connections	two (2)
Outgoing Signal Connections	one (1)
Return to Rail	one (1)

(e) Wires connected to track shall be rubber-covered solid-drawn copper.

(f) Number fourteen (14) or larger B. & S. gauge wire shall be used for all connections from main line to pole line or cable, including connections.

(g) Number five (5) or larger B. & S. gauge wire shall be used for connections of motor to battery.

(h) Number fourteen (14) or ..... (..) B. & S.  
gauge { solid } wire shall be used in connecting light-  
          { stranded }  
ning arresters and junction terminals. 1912.

522. *Cables for low voltage circuits.*

525. *Wiring.*

(a) Wires in trunking, chases, or conduits shall be laid loosely without stretching or crowding. 1911.

(b) Not more than two (2) wires shall be connected to one (1) binding post or terminal screw, and they shall be separated by a washer. 1916.

(c) Unless otherwise specified, all wires shall be run as separate conductors. 1911.

(d) Housings for primary track batteries shall be wired for three (3) cells. 1916.

(a) Wires shall, as far as practicable, be continuous without joints between interlocking machine and the unit operated; joints when made shall be in junction boxes, and only made with permission from the Purchaser's representative.

1916.

(b) In making joints braid shall be removed for a distance of one (1) inch from end of rubber on each side of joint, and rubber cut with knife held at an angle approximately thirty (30) degrees with axis of wire, as one





527. *Joints in wire.*—Continued.

would sharpen a pencil, care being taken to prevent injury from small cuts or nicks. 1916.

(c) Wire, after being cleaned, shall be twisted together in the form of a regular line wire ("Western Union Joint"), turns being spaced approximately one-sixty-fourth ( $1/64$ ) inch, or ..... 1916.

(d) The branch wire, after being cleaned, shall be wrapped around main wire, turns being spaced approximately one-sixty-fourth ( $1/64$ ) inch. 1916.

(e) Joints shall then be soldered by pouring on them, or dipping them into melted solder, a non-corrosive flux being used. After soldering, joints shall be covered with two (2) layers of rubber insulating tape between ends of braid, which tape shall be heated sufficiently to form a tight covering, but not enough to injure the quality of the material; insulating tape shall be in accordance with R. S. A. specification for "Rubber Insulating Tape." Two (2) layers of friction tape shall be applied over the rubber insulation and the ends of the braiding, and this tape shall then be thoroughly coated with black asphaltum paint. The friction tape shall be in accordance with R. S. A. specification for "Friction Tape." 1916.

530. *Tagging.*

*Field work.*

(a) Wires shall be identified near all terminals by means of a non-metallic tag or label, on which is stamped the wire designation corresponding to that shown on the circuit and wiring plan. 1916.

(b) Where practicable, the tags shall be securely fastened adjacent to the terminal, so that the number can be easily read. 1916.

(c) Wires shall be tagged at all junction boxes, switches, signals, relay boxes, arrester boxes and at all line wire connections, unless otherwise specified. 1911.

(d) Metal tags identifying line wires shall be nailed to crossarms below pins. 1916.

PETROLEUM ASPHALTUM

532. *Petroleum asphaltum.*

*Material.*

(a) Petroleum asphaltum shall be in accordance with R. S. A. specifications. 1916.

- (c) Wire after being cleaned shall be covered to-  
jointly, joints being spaced approximately one-eighth  
fourth to one-half inch, as follows:  
(1) The branch wire after being cleaned shall be  
washed covered main wire, turns being spaced approxi-  
mately one-eighth to one-half inch.  
(e) Joints shall then be soldered by dipping the branch or  
dipping them into molten solder.

WIRE IN TUBING

Which shall be heated sufficiently to form a tight con-  
tact, but not enough to injure the quality of the material.  
insulating tape shall be in accordance with R. S. A. spec-  
ification for "Rubber-insulating tape". The tape shall be  
laid on the wire and the ends of the tape shall then be  
thoroughly coated with black asphaltum paint. The tape  
shall be in accordance with R. S. A. specification.

- (a) Wires shall be identified with all terminals by means  
of a non-metallic tag or label on which is stamped the  
wire designation corresponding to that shown on the cir-  
cuit and wiring diagram.  
(b) Where practicable the tags shall be securely fast-  
ened adjacent to the terminal so that the number can be  
easily read.  
(c) Wires shall be tagged at all junction boxes,  
switches, signal relay boxes, terminal boxes and at all other  
points.  
(d) Metal tags identifying line wires shall be marked so  
crossing below pins.

(a) Petroleum asphaltum shall be in accordance with  
R. S. A. specifications.

532. *Petroleum asphaltum*.—Continued.

### Field work.

(b) When specified, the wires in the trunking shall be loosely bound and shall be so laid in pitch as to be practically free of contact with all walls of the trunking. 1911.

(c) When petroleum asphaltum is used, terminal box bootlegs, trunking and bootleg terminals shall be in accordance with R. S. A. drawings 1154, 1155, 1156 and 1157.

1915.

## BONDING

540. *Bonding wires.*

### Material.

(a) Bonding wires shall be in accordance with R. S. A. specifications. 1916.

### Field work.

(b) Bonding shall be in accordance with .....  
drawing ..... Rail joints shall be bonded with

two (2) { E. B. B. galvanized iron  
copper clad  
copper } bonding wires, ex-

cept where joints are located in station platforms or road crossings or where planking is maintained between rails, in which cases each joint shall be bonded with four (4) { copper clad } bonding wires, two (2) being placed on { copper } inside of rail behind angle bars and two (2) on outside of rail outside of angle bars.

In tunnels each joint shall be bonded with two (2)  $\left\{ \begin{array}{l} \text{copper clad} \\ \text{copper} \end{array} \right\}$  bonding wires 1916.

(c) Frogs shall be bonded in the same manner as the rail joints and shall be so connected that the continuity of the track circuit will be broken when they are removed from the track.

542. *Channel pins.*

(a) Channel pins shall be in accordance with R. S. A. specification. Single channel pins shall be in accordance with R. S. A. drawing 1086. 1916.

Section 100-100000

Section 100-100000

Section 100-100000

(b) When specified, the wires in the bonding shall be bonded and shall be so bonded as to be protected from contact with all wires of the bonding.

(c) When specified, the bonding shall be in accordance with R. S. A. drawings 100-100000 and 100-100000.

Section 100-100000

Section 100-100000

Section 100-100000

Section 100-100000

Section 100-100000

Section 100-100000

Section 100-100000

Section 100-100000

(b) Bonding shall be in accordance with R. S. A. drawings 100-100000 and 100-100000. Rail joints shall be bonded with E. B. E. galvanized iron bonding wires, or copper clad bonding wires.

When where joints are located in station platforms or near crossings or where plating is maintained between rails, in which cases each joint shall be bonded with four (4) copper clad bonding wires, two (2) being placed on inside of rail behind angle bars and two (2) on outside of rail outside of angle bars.

(c) In tunnels each joint shall be bonded with two (2) copper clad bonding wires.

(d) Ropes shall be bonded in the same manner as the rail joints and shall be so connected that the continuity of the track circuit will be broken when they are removed from the track.

Section 100-100000

(a) Channel pins shall be in accordance with R. S. A. specification. Single channel pins shall be in accordance with R. S. A. drawings 100-100000 and 100-100000.



542. *Channel pins.—Continued.*

*Field work.*

(b) Bonding shall be completed the same day that holes are drilled. 1911.

(c) When single channel pins are used, the groove shall be turned down. 1916.

BATTERIES

550. *Type of battery.*

*Material.*

(a) All batteries shall be in accordance with R. S. A. specifications. 1916.

(b) Track batteries shall be of ..... type and of ..... capacity. 1916.

(c) Line batteries shall be of ..... type and of ..... capacity. 1916.

(d) Operating batteries shall be of ..... type and of ..... capacity. 1916.

(e) Jars for caustic soda type of battery shall be

{ barrel shape }	{ heat resisting glass. }	
{ straight-sided }	{ porcelain. }	1916.

551. *Batteries.*

*Field work.*

(a) Each track circuit operated by primary battery shall not have less than two (2) cells connected in multiple. 1916.

(b) Each line battery shall have ..... (..) cells connected in ..... 1916.

(c) Each operating battery shall have ..... (..) cells connected in ..... 1916.

(d) The same battery { may } be used for the operation of line and operating circuits. { may not } 1916.

(e) One operating battery may be used for operating ..... signals and ..... line relays. 1916.

CONTROL APPARATUS

600. *Relays.*

Relays shall be in accordance with R. S. A. specification for "D.C. Neutral Type Relays." 1916.

610. *Circuit controllers.*

*Material.*

(a) Circuit controllers of substantial construction and positive in action shall be connected to switches as speci-

- (b) Bonding shall be completed the same day that holes are drilled.
- (c) When single channel pins are used, the ground shall be bonded.

- (a) All batteries shall be in accordance with R. S. A. specifications.
- (b) Tank batteries shall be of ... type and ... capacity.
- (c) Line batteries shall be of ... type and ... capacity.
- (d) Operating batteries shall be of ... type and ... capacity.
- (e) Jars for testing and type of battery shall be ...

- (a) Each track circuit operated by primary battery shall not have less than two (2) cells connected in series.
- (b) Each line battery shall have ... cells connected in series.
- (c) Each operating battery shall have ... cells connected in series.
- (d) The same battery may not be used for the operation of line and operating circuits.
- (e) One operating battery may be used for operating signals and ...

Relays shall be in accordance with R. S. A. specifications for "D.C. Neutral Type Relays".

Control controllers of substantial construction and positive in action shall be connected to switches as specified.

610. *Circuit controllers.* (a)—Continued.

fied and shall be so constructed that they can be maintained to make or break circuit when switch point shall be moved from the closed position three-sixteenths ( $\frac{3}{16}$ ) inch, or ..... (..) of an inch. 1915.

(b) Operating rods of switch circuit controller shall be not less than three-fourths ( $\frac{3}{4}$ ) inch in diameter and adjustable, with a maximum distance of three (3) feet between supports. 1915.

(c) Circuit controllers for non-interlocked switches where shunt is required shall have two independent shunt connections to the track circuit of each track affected by the opening of the switch, and shall shunt track when switch point shall have been opened from the closed position three-sixteenths ( $\frac{3}{16}$ ) inch or ..... (..). 1916.

(d) Non-interlocked single main line switches, both ends of crossover switches and hand-operated siding derails shall be equipped with one (1) switch circuit controller unless otherwise specified. 1916.

*Field work.*

(e) The switch circuit controller shall be positively connected to one or both points; if but one, the normally ..... point shall be selected. 1911.

(f) Switch circuit controllers used for selector purposes shall be insulated from the gauge plate and from the track. 1916.

(g) Plunger lock circuit controller shall be used when specified. 1916.

(h) Contacts for shunting connections shall be adjusted to spring closed and contacts for line connections shall be adjusted to spring open in addition to being mechanically forced each way. 1916.

615. *Electric locks.*

*Material.*

(a) Electric locks shall be in accordance with ..... specifications and shall be of ..... type. 1916.

*Field work.*

(b) Electric locks shall be installed as required by the Purchaser. 1916.



618. *Releases.*

*Material.*

- (a) Releases shall be in accordance with ..... specifications for mechanical and electrical releases, and shall be of ..... type. 1916.

*Field work.*

- (b) Releases shall be installed as required by the Purchaser. 1916.

625. *Indicators.*

*Material.*

- (a) Indicators shall be in accordance with ..... specifications and shall be of ..... type. 1916.

*Field work.*

- (b) Indicators shall be installed as required by the Purchaser. 1916.

630. *Annunciators.*

*Material.*

- (a) Annunciators shall be in accordance with ..... specifications and shall be of ..... type. 1916.

*Field work.*

- (b) Annunciators shall be installed as required by the Purchaser. 1916.

635. *Lightning arresters.*

*Material.*

- (a) Lightning arresters { shall  
  shall not } be used. 1916.  
(b) Where used, lightning arresters shall conform to R. S. A. requisites. 1916.

TRUNKING, CONDUITS AND SUPPORTS

700. *Trunking.*

*Material.*

- (a) All trunking and capping shall be ..... lumber and in accordance with R. S. A. specifications. 1916.

- (b) The dimensions for trunking shall be in accordance with the following R. S. A. drawings: 1176 and 1177. 1916.

*Field work.*

- (c) The location of the main run of trunking is shown on ..... drawing ..... 1911.



(a) Releases shall be in accordance with specifications for mechanical and electrical releases and shall be of ..... type.

Field work.  
(b) Releases shall be installed as required by the Purchaser.

Material.  
(a) .....  
(b) .....  
Field work.

(b) Indicators shall be installed as required by the Purchaser.

(a) Annunciators shall be in accordance with ..... specifications and shall be of ..... type.

Field work.  
(b) Annunciators shall be installed as required by the Purchaser.

(a) Lightning arresters shall be used where necessary.  
(b) Where used, lightning arresters shall conform to R. S. A. requisites.

TRUNKING, CONDUITS AND SUPPORTS

(a) All trunking and capping shall be .....  
lumber and in accordance with R. S. A. specifications.

(b) The dimensions for trunking shall be in accordance with the following R. S. A. drawings: 170 and 175.

Field work.  
(c) The location of the main run of trunking is shown on ..... drawing.

700. *Trunking.—Continued.*

(d) Permission shall be obtained when it becomes necessary to place runs of trunking between tracks parallel with tracks. 1916.

(e) Trunking, when on stakes above ground and running parallel with the track, shall not be placed nearer than six (6) feet from the gauge side of the nearest rail, except by special permission. 1911.

(f) Local conditions shall determine the height of trunking when above ground; in general when trunking is run parallel with the tracks, bottom of trunking shall be placed approximately six (6) inches above ground. 1911.

(g) Trunking shall be so installed that there will be sufficient slope for drainage. 1916.

(h) Nails shall not be driven through the trunking from the inside of the groove, nor shall they be driven into the groove from the outside. 1911.

(i) Inside corners of trunking at turns must be rounded to prevent injury to insulation on wires. 1916.

(j) Surfaces of trunking that are to be painted shall be finished. 1911.

(k) Not less than one-third ( $1/3$ ) of the capacity of the groove shall remain free for the further installation of wires. 1911.

(l) Capping shall be securely fastened to the trunking in a manner satisfactory to the Purchaser. 1916.

703. *Joints in trunking.*

*Field work.*

(a) Joints in trunking shall be  $\left\{ \begin{array}{l} \text{lapped} \\ \text{mitered} \end{array} \right\}$  and shall be made in a manner satisfactory to the Purchaser. 1916.

(b) Joints in built-up trunking shall be staggered. 1911.

(c) Joints in capping shall be made at least one (1) foot from joints in trunking. 1911.

705. *Trunking supports.*

*Material.*

(a) Stakes shall be made of ..... three by four (3x4) inches, or of equivalent circular section and of sufficient length to allow them to be placed at least two (2) feet in the ground. When, due to local requirements, stakes are of a greater length than three (3) feet six (6)

104. Trunking—General

(a) Trunking shall be installed in a manner satisfactory to the Purchaser. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached.

(b) Trunking shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached.

(c) Trunking shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached.

(d) Trunking shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached.

(e) Trunking shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached.

(f) Trunking shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached.

(g) Trunking shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached. It shall be installed in a manner that will not interfere with the operation of the equipment to which it is attached.

705. *Trunking supports.* (a)—Continued.

inches, or a greater cross section than three by four (3x4) inches will be necessary, information as to the number, length, and cross section will be furnished by the Purchaser. 1915.

*Field work.*

(b) Trunking above ground shall be supported on stakes placed not more than five (5) feet centers. 1911.

(c) When trunking exceeds a width of seven (7) inches a special arrangement consisting of

{ a double line of stakes }  
{ a single line of stakes } shall be installed, or provision shall be as follows:.....

1916.

(d) Stakes supporting trunking shall be placed vertically and extend at least two (2) feet below the surface of the ground unless otherwise specified. 1911.

(e) A piece of capping eight (8) inches long and the width of the trunking shall be placed between the trunking and each stake. Ends of capping shall be beveled. 1916.

(f) Each joint in the bottom of the trunking above ground shall be supported by a stake. 1916.

(g) When trunking is extended across ditch or other depression necessitating a span of more than two (2) feet, trunking shall be supported by a piece of rough yellow pine or oak four by six (4x6) inches in size laid horizontally and with suitable supports under end of reinforcing piece. 1916.

(h) Exposed trunking crossing under tracks containing other than track circuit wires shall be protected with metal covering in a manner satisfactory to the Purchaser. 1916.

708. *Bootlegs.*

Bootlegs for track connection shall conform to ..... drawing ..... They shall be securely fastened to the trunking, not less than two (2) inches from base of rail, and shall not exceed more than one (1) inch above base of rail. 1916.

710. *Junction boxes.*

*Material.*

(a) Junction boxes shall be made of ..... and so designed that terminals will be kept dry. Each junction box shall be fitted with a cover, hasp and staple. 1911.

70. Trunking is supported. (a) —Continued.  
Trunking or a greater cross section than three by four (3x4) inches will be necessary. Information as to the number, length, and cross section will be furnished by the Purchaser.

Field work.  
(b) Trunking above ground shall be supported on stakes placed not more than five (5) feet centers. (c) When trunking extends a width of seven (7) inches a special arrangement consisting of a double line of stakes (d) shall be installed on one side and a single line of stakes on the other.

(d) Stakes supporting trunking shall be placed vertically and extend at least two (2) feet below the surface of the ground unless otherwise specified. (e) A piece of capping eight (8) inches long and the width of the trunking shall be placed between the trunking and each stake. Ends of capping shall be beveled.

(f) Each joint in the bottom of the trunking above ground shall be supported by a stake. (g) When trunking is extended across ditch or other excavation necessitating a span of more than two (2) feet, the trunking shall be supported by a piece of rough yellow pine or oak four by six (4x6) inches in size laid horizontally across the ditch.

(h) Trunking above ground shall be protected with other than black circuit wires shall be protected with metal covering in a manner satisfactory to the Purchaser.

710. Junction boxes. (a) Junction boxes shall be made of metal. They shall be accurately fastened to the trunking, not less than two (2) inches from base of rail, and shall not exceed more than one (1) inch above base of rail.

(b) Junction boxes shall be made of metal. They shall be accurately fastened to the trunking, not less than two (2) inches from base of rail, and shall not exceed more than one (1) inch above base of rail.



710. *Junction boxes.*—Continued.

(b) Where ten (10) or less wires are used, junction boxes shall be sixteen (16) inches square by twenty (20) inches deep, inside dimensions, and shall be increased six (6) inches in length for each ten (10) additional connections or fraction thereof made in the box. 1911.

(c) Junction terminals shall be in accordance with R. S. A. drawing 1056. 1915.

*Field work.*

(d) Junction boxes shall be located as shown on . . . . . drawing . . . . . and at a height sufficient to allow terminals to be placed at least six (6) inches above top of trunking. 1911.

(e) Junction boxes shall be supported in the same manner as the trunking. 1911.

711. *Conduits.*

*Material.*

(a) Fibre conduits shall be in accordance with R. S. A. specifications. 1916.

(b) Vitrified clay conduits shall be in accordance with R. S. A. specifications. 1916.

714. *Line construction.*

Line construction shall comply with local laws. 1912.

715. *Line supports.*

(a) Line wire supports shall be in accordance with R. S. A. drawings 1089, 1165, 1166, 1219 and 1220. 1916.

(b) Aerial cable shall be supported by messenger wire. Messenger wire shall be in accordance with R. S. A. specifications, and shall be supported in a manner satisfactory to the Purchaser. 1916.

(c) Cable shall be supported on messenger wire by hooks and marlin loops or by . . . . . 1911.

(d) Line wire supports shall be furnished in place by . . . . . 1911.

on the ground of the...  
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(1) Where the...  
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Continued

Material

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 (2) Where the...  
 (3) Where the...  
 (4) Where the...  
 (5) Where the...

This consists of all the... and...

are suggested

(1) Where the...  
 (2) Where the...  
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 (4) Where the...  
 (5) Where the...  
 (6) Where the...  
 (7) Where the...  
 (8) Where the...

718. *Cable boxes.*

- (a) Cables shall terminate in cable boxes in accordance with ..... drawing ..... 1911.  
(b) Cable boxes shall be furnished in place by .....  
..... 1911.

INSTRUMENT AND BATTERY SHELTERS

720. *Relay boxes.*

- (a) Relay boxes at signals and track circuit limits shall be in accordance with ..... drawing  
..... and shall be made of  $\left\{ \begin{array}{l} \text{wood.} \\ \text{cast iron.} \end{array} \right\}$   
Cast iron boxes in accordance with R. S. A. drawings 1182  
and 1185, and shall be supported as required by the Purchaser. 1916.

*Field work.*

- (b) Terminals in relay boxes shall be arranged in accordance with ..... drawing ..... 1915.

721. *Relay cases.*

- Relay cases for interlocking station shall be in accordance with ..... drawing ....., and shall be neatly finished and dustproof. 1911.

722. *Lightning arrester boxes.*

- Boxes for housing lightning arresters shall be in accordance with ..... drawing .....  
..... 1911.

725. *Battery chutes.*

- (a) Battery chutes shall be of  $\left\{ \begin{array}{l} \text{cast iron.} \\ \text{concrete.} \end{array} \right\}$  Cast iron  
chutes shall be in accordance with R. S. A. drawing 1228  
or 1229. 1916.  
(b) Elevators for battery chutes shall be in accordance  
with R. S. A. drawing 1227. 1915.

728. *Battery wells and boxes.*

- (a) Battery wells and boxes shall conform to .....  
..... drawing ..... 1916.  
(b) Concrete battery wells shall be ..... (..) feet in diameter, ..... (..) feet high, inside dimensions, and shall be water-tight. 1911.  
(c) Frost neck ..... (..) feet in diameter, ..... (..) feet in height, shall be furnished for each well. 1911.

1000-1000

(a) Labels shall be placed in accordance with the following:

(b) The boxes shall be furnished in the following manner:

(c) Boxes shall be furnished in accordance with the following:

(d) Boxes shall be furnished in accordance with the following:

(e) Boxes shall be furnished in accordance with the following:

(f) Boxes shall be furnished in accordance with the following:

1000-1000

Boxes for housing the following shall be furnished:

(a) Boxes shall be furnished in accordance with the following:

(b) Boxes shall be furnished in accordance with the following:

1000-1000

(c) Boxes shall be furnished in accordance with the following:

(d) Boxes shall be furnished in accordance with the following:

(e) Boxes shall be furnished in accordance with the following:

728. *Battery wells and boxes.*—Continued.

(d) Concrete battery boxes shall be ..... (..) feet ..... (..) inches by ..... (..) feet ..... (..) inches and ..... (..) feet high, inside dimensions, shall be water-tight, and shall be provided with frost protection. 1915.

(e) Durable wood covers protected by number eighteen (18) galvanized iron shall be provided. The covers shall conform to ..... drawing ..... The covers shall be fastened with properly arranged chain or iron strap and provision made for locking. 1916.

(f) Shelving shall be arranged in the well and shall conform to ..... drawing ..... 1916.

INSULATIONS

735. *Insulated rail joints.*

*Material.*

(a) Insulated rail joints shall be in accordance with ..... drawing ..... and shall be furnished by the ..... 1916.

*Field work.*

(b) Insulated rail joints shall be installed in accordance with ..... drawing ..... 1916.

738. *Switch rod insulations.*

*Material.*

(a) Switch rod insulations shall be in accordance with R. S. A. drawing 1055, and shall be furnished by the.... 1916.

*Field work.*

(b) Switch rod insulations shall be installed in accordance with ..... drawing ..... 1916.

742. *Pipe line insulations.*

*Material.*

(a) Pipe line insulations shall be in accordance with R. S. A. drawing 1094. 1915.

*Field work.*

(b) Pipe line insulations shall be installed in accordance with ..... drawing ..... 1916.

744. *Gauge plate insulations.*

Gauge plate insulations shall be in accordance with....  
..... drawing ..... 1916.

748. *Insulating fibre.*

Insulating fibre shall be in accordance with R. S. A. specification. 1916.





800. *Paint.*

*Material.*

(a) Purchaser shall indicate here the kind of paint that shall be required .....

1911.

*Field work.*

(b) Surfaces covered with rust, grease, dirt or other foreign substances shall be thoroughly cleaned before paint or oil is applied. ....

1911.

(c) Paint shall not be applied to outside surfaces in freezing weather, nor to wet surfaces, nor until previous coating has thoroughly dried. ....

1911.

(d) Finishing coats shall not be applied until after the expiration of forty-eight (48) hours after the previous coating has been applied. ....

1911.

(e) Paints mixed on the ground shall be applied within three (3) hours after the pigment and oil are mixed. ....

1911.

(f) Priming coats shall be applied as soon as is consistent with the progress of the work. ....

1911.

(g) Second coat shall be applied in sufficient time for the third or finishing coat to be applied and dry when the installation is completed. ....

1916.

(h) Iron work (except machine gauge plates, iron foundation piers), not galvanized, shall be painted one (1) coat of red lead and raw linseed oil and two (2) finishing coats. ....

1916.

(i) The following specific finishing coats shall be used:

	Kind of Paint.	Color.
Signal Bridges and Brackets .....		
Signal Masts .....		
All Connections .....		

1916.

(j) Outside iron connections, switch and signal fittings, not machine finished, shall be dipped in raw linseed oil before shipment from works. ....

1911.

(k) Exposed wood work shall be given one (1) priming coat and finishing coats as follows:

1. 11/17/73

800. *Paint.*—Continued.

	Kind of Paint.	Color.	Number of Coats.
Home Signal Blades	.....	.....	.....
Distant Signal Blades	.....	.....	.....
Trunking, Junction			
Boxes, etc.	.....	.....	.....
Foundation Tops and Bottoms	.....	.....	.....
			1916.

900. *Special items.*

.....			
.....			1911.

925. *Locks.*

Purchaser's standard locks shall be furnished by the  
..... and shall be used where specified. 1915.

926. *Number plates and numbers.*

(a) Number plates	.....	
.....		
.....		1911.
(b) Numbers	.....	
.....		
.....		1911.

1/10/68

Kindly

Return

Thomas Edward Thomas

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YOUNG MAN

SHOULD BE INVESTIGATED BY THE  
PURCHASER'S STANDARD

(2) New car plate

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## SPECIFICATION FOR LEAD TYPE PORTABLE STORAGE BATTERY FOR SIGNALING.

1916.

### 1. Designation.

(a) In ordering cells or parts, the capacity required shall be designated as "40 ampere hour," "60 ampere hour," "80 ampere hour" or "100 ampere hour." These terms shall signify, on the basis of a two (2) ampere rate per cell, the capacity and dimensions thus designated in this specification.

(b) Each cell shall include electrolyte, positive and negative groups, cell cover with vent lug, separators, hold downs, rubber jar, connecting straps and terminals for joining adjacent cells, and shall be completely assembled and sealed with insulating compound.

### 2. Assembly.

Unless otherwise specified, the cells shall be assembled in wooden carrying cases in accordance with R. S. A. drawing 1248, and shall be given the full initial charge before shipment.

### 3. Dimensions.

Ampere Hour Service Capacity	Number of Plates	Ampere Charging Rate Max.	Rate Min.	"B" Length of Jars Inches	"A" Length of Case Inches	Number of Cells	Approx. Weight Com- plete
40	5	4	2	1 3/16	3 3/4	1	10
					5 7/8	2	20
					8	3	30
					10 7/8	4	40
					12 1/4	5	50
					14 3/8	6	60
60	7	6	3	2 9/16	4 1/2	1	14
					7 3/8	2	28
					10 1/4	3	42
					13 3/8	4	56
					16	5	70
					18 7/8	6	84
80	9	8	4	3 1/4	5 1/4	1	18
					8 3/4	2	36
					12 1/4	3	54
					15 3/4	4	72
					17 1/4	5	90
					6 1/4	1	22
100	11	10	5	4 1/4	10 3/4	2	44
					15 1/4	3	66
					19 3/4	4	88



4. *Elements.*

(a) The plates shall be connected into positive and negative groups by burning to lead alloy pillar straps.

(b) The positive and negative plates shall be of pasted type approximately five (5) inches square.

(c) Positive plates shall be not less than seven-thirty-seconds ( $7/32$ ) inch thick. Intermediate negative plates shall not be less than three-sixteenths ( $3/16$ ) inch thick. End negative plates shall not be less than three-thirty-seconds ( $3/32$ ) inch thick.

(d) Negative groups when furnished separately shall be ready for service after initial charge of one and one-fourth ( $1\frac{1}{4}$ ) amperes per positive plate continued from sixty (60) to seventy (70) hours.

(e) Positive groups when furnished separately shall have been fully charged.

5. *Separators.*

(a) Adjacent plates shall be separated by a sheet of hard rubber and a sheet of treated wood.

(b) The wood sheet shall be at least three-thirty-seconds ( $3/32$ ) inch thick, grooved on one side, and the rubber sheet shall be perforated and not less than one-sixty-fourth ( $1/64$ ) inch thick. The flat side of wood shall be placed against the negative plate.

6. *Electrolyte.*

Electrolyte shall be dilute sulphuric acid, 1.300 specific gravity, and shall comply with R. S. A. specification for "Electrolyte for Lead Type Storage Battery."

7. *Jars.*

(a) The jars shall be of hard rubber with a tinfoil finish on outside vertical surfaces, free from foreign matter, soft spots or flaws, and shall have the same outside dimensions at the top and bottom.

(b) The wall of the jar should be of a uniform thickness, not less than three-thirty-second ( $3/32$ ) inch, and shall have not more than one-sixteenth ( $1/16$ ) inch draft between the top and the inside of the jar at the top of the ribs. A variation of one-sixty-fourth ( $1/64$ ) inch under the outside dimensions will be allowed. The corners shall be made true and as sharp as consistent with strength. The top shall be ground to a true surface.

(c) The bottom of the jar shall be reinforced on all sides and beneath the ribs. The ribs for supporting the plates shall be made of a harder compound than the walls. They must be of a uniform height, not less than one-eighth ( $1/8$ ) inch thick on the top. Ribs shall be cham-



7. *Jars.—Continued.*

fered and securely fastened to the sides and bottom of the jars. The sediment space shall be at least one-sixth ( $1/6$ ) the height of the plates.

(d) The jars when supported in the case shall withstand an increase in temperature of the electrolyte to one hundred and fifty (150) degrees Fahr. without distortion.

8. *Jar covers.*

Covers shall be of the same material as the jars, not less than one-eighth ( $1/8$ ) inch and shall fit neatly. They shall be provided with a tapped hole for the vent and with two (2) holes for the cell terminal posts.

9. *Vents.*

A hard rubber vent, approximately one and one-half ( $1\frac{1}{2}$ ) inches long and one (1) inch outside diameter shall be threaded into jar cover. The vent shall be provided with a removable screw cap so vented that gas will readily escape without carrying entrained electrolyte.

10. *Cell connections.*

The connections shall be of lead alloy burned to the terminal posts.

11. *Case.*

(a) The case shall be made of well seasoned oak, maple or ash.

(b) The sides and ends shall be at least five-eighth ( $5/8$ ) inch thick with horizontal grain and shall be fastened together by dovetail or lock corners. The sides shall be fastened to the bottom with one and one-quarter ( $1\frac{1}{4}$ ) inch No. 8 flat head screws.

(c) The bottom shall be of three (3) pieces, at least five-eighth ( $5/8$ ) inch thick, forming tongue and groove expansion joints.

(d) A hand iron strap one (1) inch by three-thirty-second ( $3/32$ ) inch shall extend down the ends and across the bottom. The strap shall be flush with the bottom only, fastened to the ends with flat head screws and shall have an opening near the top on both ends to receive the hooked end of bail.

12. *Case cover.*

(a) The top of case cover shall be at least one-half ( $1/2$ ) inch thick and shall be fastened to the cover, side and ends, with one and one-fourth ( $1\frac{1}{4}$ ) inch No. 8 flat head screws. The sides and ends of the case cover shall be five-eighth ( $5/8$ ) inch thick.



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12. *Case covers.*—Continued.

(b) The case cover shall be hinged and provided with clasps to hold the cover in place.

13. *Case handle.*

The case shall be provided with a handle, which shall consist of a steel rod bail, five-sixteenth ( $5/16$ ) inch in diameter, and a handle of well seasoned maple, ash, oak or beech one and one-quarter ( $1\frac{1}{4}$ ) inches in diameter, extending the full length of the case.

14. *Sealing compound.*

(a) The sealing compound shall be of such composition as not to have an injurious effect on the battery.

(b) The sealing compound shall not be brittle at twenty-five (25) degrees Fahr. below zero; shall not run at one hundred and fifty (150) degrees Fahr. and shall not melt at two hundred (200) degrees Fahr.

15. *Sealing.*

(a) The clearance between the jars and between the jars and the case shall not be less than three-sixteenth ( $3/16$ ) inch thick.

(b) Hardwood supporting strips (paraffin treated) not less than three-sixteenth ( $3/16$ ) inch thick and one (1) inch wide, shall be placed under the jars below the ribs.

(c) The jars shall be secured in place with sealing compound, or by filling the surrounding and intermediate spaces with packing boards impregnated with paraffin. After the cell covers are sealed and the connections are made, the compound shall be poured to a depth of at least one-fourth ( $1/4$ ) inch over all parts except the vents and end cell terminals and flush with the top edges.

16. *Battery terminals.*

The battery end cells shall each be equipped with a terminal lead alloy post with a detachable binding post, in accordance with R. S. A. drawing 1070. The post shall be so constructed as to prevent turning of binding post and creeping of electrolyte.

17. *Inspection at factory.*

(a) The Purchaser is to have the right to make such inspection of the completed product as is necessary to assure him that the requirements of the specification have been complied with.

(b) The Purchaser shall be permitted to make desired inspection at all stages of manufacture.

(c) If upon arrival at destination, the material does not meet the requirements of this specification it may be rejected and returned to the Manufacturer, who shall pay all freight charges.

(b) The case cover shall be hinged and provided with clasps to hold the cover in place.

The case shall be provided with a handle, which shall consist of a steel rod half five-eighths (5/16) inch diameter and a handle of well seasoned maple, oak or beech one and one-quarter (1 1/4) inches in diameter, extending the full length of the case.

#### 14. Sealing compound.

(a) The sealing compound shall be of such composition as not to have an injurious effect on the battery.

(b) The sealing compound shall not be plastic at twenty-five (25) degrees Fahrenheit; shall not run at one hundred (100) degrees Fahrenheit and shall not melt at two hundred (200) degrees Fahrenheit.

(c) The clearance between the jars and between the jars and the case shall not be less than three-eighths (3/8) inch thick.

(d) Hardwood supporting strips (pawls) treated with preservative shall be placed under the jars and one (1) inch wide, shall be placed under the jars below the top.

(e) The jars shall be secured in place with sealing compound, or by fitting the surrounding and supporting spaces with packing boards impregnated with preservative. After the cell covers are sealed and the connections are made, the compound shall be poured to a depth of at least one-fourth (1/4) inch over all joints except the vent and end cell terminals and flush with the top surface.

The battery and cells shall each be equipped with a terminal lead at any point with a detachable fitting good in accordance with U. S. A. drawing 200. The point shall be so constructed as to prevent leakage of liquid and prevent creeping of electrolyte.

#### 17. Inspection at factory.

(a) The Purchaser is to have the right to make such inspection of the completed product as is necessary to assure him that the requirements of the specification have been complied with.

(b) The Purchaser shall be permitted to make factory inspection at all stages of manufacture.

(c) If upon arrival at destination, the material does not meet the requirements of this specification it may be rejected and returned to the Manufacturer, who shall pay all freight charges.

18. *Test.*

(a) Manufacturer shall give the Purchaser sufficient notice of time when material will be ready for testing.

(b) Manufacturer shall provide, at point of production, apparatus and labor for making the required tests under the supervision of the Purchaser.

(c) Tests may be made at point of production or on samples submitted and may also be made at destination.

(d) The following test shall be made at the option of the Purchaser on ten (10) per cent. of the number of batteries ordered. The batteries shall be selected by the Purchaser from the proposed shipment and shall, after being fully charged, be discharged and charged as per outline.

1. Discharge at the rate of two (2) amperes per positive plate to average cell voltage of 1.75.

2. Charge at above rate to one hundred and twelve (112) per cent. in ampere hours of previous discharge.

3. Discharge at same rate to average cell voltage of 1.75.

4. The ratio of the ampere hours of the last discharge, 3 to the ampere hours of preceding charge, 2 will be the efficiency. This efficiency shall be not less than eighty-eight (88) per cent.

5. The interval, in each case, between charge and discharge, shall not exceed one (1) hour and between discharge and charge fifteen (15) minutes.

6. Corrections shall be made for temperature changes during test.

(e) New cells shall develop on an eight (8) hour discharge rate eighty (80) per cent. of service capacity rating given in the table of Section 3.

19. *Packing.*

Material shall be packed so as to permit convenient handling and to prevent loss or damage during shipment.

20. *Marking.*

Purchaser's order and requisition number, name of Consignor and name and address of Consignee, also details of contents, shall be plainly marked on outside of package.

(c) Manufacturer shall give the Purchaser sufficient notice of time when material will be ready for testing.  
(d) Manufacturer shall provide at point of production, storage and later for making the required test, the supervision of the test.

(e) Tests may be made at point of production or at any other place and may also be made at destination.  
(f) The following test shall be made at the option of the Purchaser on ten (10) per cent of the number of batteries ordered. The batteries shall be discharged and charged as per instructions given in the proposed report and shall then be discharged and charged as per instructions.

1. Discharge at the rate of two (2) ampères per hour to average cell voltage of 1.75.  
2. Charge at above rate to one hundred and twenty (120) per cent in average hours of previous discharge.

3. Discharge at same rate to average cell voltage of 1.75.

4. The ratio of the number hours of the last discharge to the number hours of preceding charge will be the efficiency. This efficiency shall be not less than eighty-eight (88) per cent.

5. The interval in each case between charge and discharge shall not exceed one (1) hour and between discharge and three (3) hours.

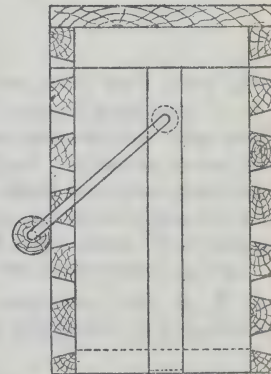
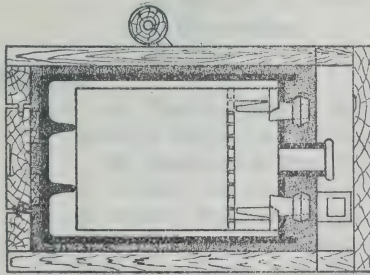
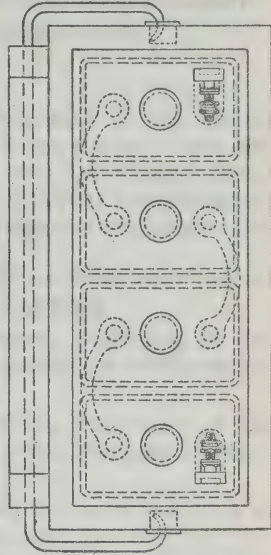
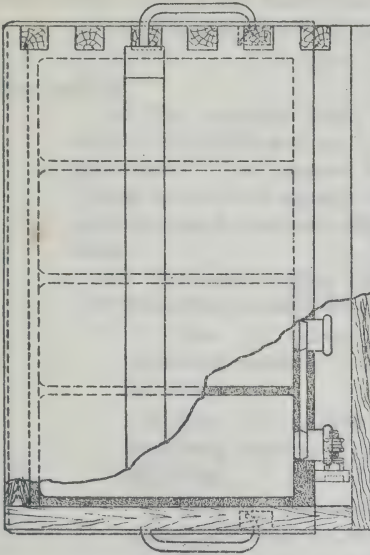
6. Corrections shall be made for temperature.

(e) New cells shall develop on an eight (8) hour discharge rate eight (8) per cent of service capacity rating given in the top of Section 2.

Material shall be packed so as to permit convenient handling and to prevent loss or damage during shipment.

Material shall be packed in the primary marked or outside of the container and shall be marked with the name of the material and the name of the manufacturer.





**PORTABLE STORAGE BATTERY**  
( LEAD TYPE.)

**RSA**  
**1248**

MAR. 1916

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SPECIFICATION FOR COMPOSITE TYPE STATIONARY  
STORAGE BATTERY FOR SIGNALING.

1916.

1. *Designation.*

(a) The capacity shall be designated as "40 ampere hour," "80 ampere hour," "120 ampere hour," "200 ampere hour," "320 ampere hour" and "400 ampere hour." These terms shall signify, on an eight (8) hour basis, the capacities and dimensions thus designated in this specification.

(b) Each cell, unless otherwise specified, shall include the following parts:

1. One (1) positive element, consisting of the necessary number of plates assembled with connecting strap.
2. One (1) negative element, consisting of the necessary number of plates assembled with connecting strap.
3. One (1) connecting bolt for each bolt hole in connecting strap of each element.
4. One (1) set of separators, with dowels, and hold downs.
5. One (1) jar, with sand tray, and cell cover.
6. Electrolyte.

2. *Elements.*

(a) Positive plates shall consist of a hard alloy grid securely supporting cylindrical forms of pure lead.

(b) Negative plates, for the 40 ampere hour size, shall be of pure lead or of the pasted type. Negative plates, for 80 ampere hour, and larger sizes, shall be either pure lead or shall be made with the active material inclosed in a hard alloy frame with finely perforated sides. End plates shall be of the same thickness as the intermediate plates.

(c) Elements shall be in accordance with R. S. A. drawing 1241, except as to the thickness of composite plates.

(d) Elements shall be ready for service after an initial charge continued from fifty (50) to sixty (60) hours at the eight (8) hour rate.

3. *Jars.*

Jars, Sand Trays, Covers and Hold Downs shall be of glass and in accordance with R. S. A. drawing 1224.



4. *Separators.*

Separators shall be of specially treated wood in accordance with R. S. A. drawing 1341, or the center dowel may be supported by a hard rubber pin, one-eighth ( $\frac{1}{8}$ ) inch by three-fourth ( $\frac{3}{4}$ ) inch, at top of veneer, and all dowels may terminate approximately one (1) inch below the bottom of the veneer.

5. *Electrolyte.*

(a) Electrolyte shall be dilute sulphuric acid, 1.210 specific gravity, and shall be in accordance with R. S. A. specification for "Electrolyte for Lead Type Storage Battery."

(b) The quantity of electrolyte per cell shall be as follows:

40 ampere hour .....	9.2 lbs. per cell.
80 ampere hour .....	15.6 " " "
120 ampere hour .....	21.1 " " "
200 ampere hour .....	29.6 " " "
320 ampere hour .....	41.0 " " "
400 ampere hour .....	59.0 " " "

6. *Guaranty.*

The material furnished shall give satisfactory and economical service.

7. *Inspection at factory.*

(a) The Purchaser is to have the right to make such inspection of the completed product as is necessary to assure him that the requirements of the specification have been complied with.

(b) The Purchaser shall be permitted to make desired inspections at all stages of manufacture.

(c) If upon arrival at destination, the material does not meet the requirements of this specification, it may be rejected and returned to the Manufacturer, who shall pay all freight charges.

8. *Test.*

(a) Manufacturer shall give the Purchaser sufficient notice of time when material will be ready for testing.

(b) Manufacturer shall provide, at point of production, apparatus and labor for making the required tests under the supervision of the Purchaser.

(c) Tests may be made at point of production or on samples submitted and may also be made at destination.

(d) The following test shall be made at the option of the Purchaser on ten (10) per cent. of the number of batteries ordered. The batteries shall be selected by the



Separate shall be of specially treated wood in section  
with S. A. drawing 1441 of the center below may  
be reported of a head number but the length (24) inch  
of the section (24) inch at top of vent and all dowels  
may terminate approximately one (1) inch below the  
bottom of the vent.

(4) The quantity of material shall be as  
specified in the drawing with S. A.  
drawing 1441.

TABLE 1

Material	Quantity
Steel	100 lbs.
Aluminum	50 lbs.
Copper	25 lbs.
Brass	10 lbs.
Lead	5 lbs.
Iron	10 lbs.
Steel	100 lbs.
Aluminum	50 lbs.
Copper	25 lbs.
Brass	10 lbs.
Lead	5 lbs.
Iron	10 lbs.

The material furnished shall be satisfactory and

the inspection factory.

(a) The Purchaser is to have the right to make such  
inspection of the completed product as is necessary to  
ascertain that the requirements of the specification

(b) The Purchaser shall be permitted to make desired  
inspections at all stages of manufacture.

(c) If upon arrival at destination the material does  
not meet the requirements of this specification it may be  
rejected and returned to the Manufacturer who shall pay

(a) Manufacturer shall give the Purchaser sufficient  
notice of time when material will be ready for testing.

(b) Manufacturer shall provide at point of produc-  
tion, inspection and report for making the required tests

(c) Tests may be made at point of production or on  
samples submitted and may also be made at destination.

(d) The following test shall be made at the option of  
the Purchaser on ten (10) per cent of the number of  
packages ordered. The packages shall be selected by the

8. *Test.*—Continued.

Purchaser from the proposed shipment and shall, after being fully charged, be discharged and charged as per outline.

1. Nor. Capacity	40	80	120	200	320	400
First Discharge	A.H	A.H.	A.H.	A.H.	A.H.	A.H
Amperes	20	40	60	100	160	200
Hours, not less than	1	1	1	1	1	1
Minimum volts per cell, not less than	1.6	1.6	1.6	1.6	1.6	1.6
First Charge						
Amperes	7	14	21	35	50	70
Second Discharge						
Amperes	5	10	15	25	40	50
Hours, not less than	8	8	8	8	8	8
Minimum volts per cell, not less than	1.75	1.75	1.75	1.75	1.75	1.75
Second Charge						
Amperes	5	10	15	25	40	50

2. During each discharge and charge, the current shall be held constant at the value specified. The voltage shall be measured while this current is flowing.

3. The second charge shall be completed in not more than one and eighteen one-hundredth (1.18) times the interval consumed in the second discharge.

4. Corrections shall be made for temperature changes during test.

(c) If positive and negative elements are ordered separately, the Purchaser may select for test, samples not exceeding ten (10) per cent. of the number ordered. The Manufacturer shall furnish the parts necessary for assembling in complete cells.

9. *Packing.*

Material shall be packed so as to permit convenient handling and to prevent loss or damage during shipment.

10. *Marking.*

Purchaser's order and requisition number, name of Consignor, and the name and address of the Consignee, also detail of contents, shall be plainly marked on outside of package.

Purchaser from the proposed shipment and shall after being fully charged, be discharged and charged as per outline.

1. Net Capacity	40	80	120	200	320	400
2. Discharge	1.5	1.5	1.5	1.5	1.5	1.5
3. Amperes	20	40	60	100	160	200
4. Hours, not less than	1	1	1	1	1	1
5. Minimum volts per cell, not less than	1.0	1.0	1.0	1.0	1.0	1.0
6. Amperes	5	10	15	25	40	50
7. Discharge	1.5	1.5	1.5	1.5	1.5	1.5
8. Amperes	20	40	60	100	160	200
9. Hours, not less than	1	1	1	1	1	1
10. Minimum volts per cell, not less than	1.0	1.0	1.0	1.0	1.0	1.0
11. Amperes	5	10	15	25	40	50

2. During test, discharge and charge the current shall be held constant at the value specified. The voltage shall be measured while this current is flowing.

The second charge shall be completed in not more than one and one-half hours (1.5). The first charge shall be made for temperature changes during test.

(a) If positive and negative elements are ordered separately, the Purchaser may select for test samples not exceeding ten (10) percent of the number ordered. The Manufacturer shall furnish the parts necessary for re-sampling in complete cells.

**Packing.**

Material shall be packed so as to prevent corrosion, handling and so prevent loss or damage during shipment.

**10. Marking.**

Purchaser's order and registration number, name of Consignor, and the name and address of the Consignee, also serial or contract shall be plainly marked on outside of packages.

## REQUIREMENTS FOR THE PROTECTION OF TRAFFIC AT MOVABLE BRIDGES.

1916.

The protective appliances at drawbridges consist in devices for insuring that the bridge is in proper position, and the track in condition for the passage of trains over draw, or for reduction to a minimum of the damage in case of trains not stopping when track is not in condition for passage of same over draw; also the usual devices for protection against damage in case of derailment.

The protective devices may be classified under the headings:

- (a) Interlocking power and bridge devices.
- (b) Bridge surfacing, aligning and fastening devices.
- (c) Rail-end connections.
- (d) Signaling and interlocking.
- (e) Guard rails.

(a) *Interlocking Power and Bridge Devices.* Interlocking the drawbridge devices so that their movements must follow in a predetermined order to protect the drawbridge machinery.

(b) *Bridge Surfacing, Aligning and Fastening Devices.* Drawbridges should be equipped with proper mechanism to surface and align them accurately and fasten them securely in position. This condition can be secured by the use of efficient end lifts in case of swing bridges, and by proper end locks in case of lift bridges.

(c) *Rail-end Connections.* Rail ends may be mitered or cut square. Mitered rails where lapped should retain the full thickness of the web to the points. The points should be trailing to normal traffic where possible; on single track bridges the points should be trailing to traffic entering the movable span.

Where rail ends are cut square or mitered and not lapped, they should be connected by sliding sleeve or joint bar or by easer rails to carry the wheels over the opening between the end of bridge and approach rails.

(d) *Signaling and Interlocking.* If trains are to proceed over drawbridges which are in service, without first stopping, interlocking should be installed which will provide that the drawspan, tracks and switches within the limits of the plant are locked in the proper position.





(d) *Signaling and Interlocking.*—Continued.

This will require:

- (1) Locking drawbridge devices.
- (2) Locking providing for the proper order of operation of signaling devices, such as signals, switches and derails.

This interlocking will require the following order of operation:

- | Before Opening a Drawbridge.       | Before Operating Trains Over Drawbridge. |
|------------------------------------|--|
| 1. Display stop signals.           | 1. Lock bridge and rail devices.         |
| 2. Unlock rail and bridge devices. | 2. Display clear signals.                |

Since there are various types and designs of drawbridges and various drawbridge devices for each of the types, and also various designs and types of signaling devices, as well as various locations, from which they all may be interlocked and operated, a typical example only of the detail order of operations is given; viz., a swing-bridge with all its devices operated from one location on the draw-span, having home and distant signals, derails, etc.

- | To Open Drawbridge.  | To Pass Trains Over Drawbridge.  |
|--|--|
| 1. Display stop signals.   | 1. Close bridge.   |
| 2. Unlock derails.   | 2. Insert bridge surfacing, aligning and fastening devices.  |
| 3. Open derails.   | 3. Insert rail-end connections.  |
| 4. Uncouple interlocking connections.  | 4. Operate power-controlling device to position preventing application of power to bridge machinery. |
| 5. Unlock rail-end connections.  | 5. Lock bridge surfacing, aligning and fastening devices.  |
| 6. Unlock bridge surfacing, aligning and fastening devices.  | 6. Lock rail-end connections.  |
| 7. Operate power-controlling device to position permitting application of power to bridge machinery. | 7. Couple interlocking connections.  |
| 8. Withdraw rail-end connections.  | 8. Close derails.  |
| 9. Withdraw bridge surfacing, aligning and fastening devices.  | 9. Lock derails.   |
| 10. Open bridge.   | 10. Display clear signals.   |

1. Lock bridge and rail devices

span, having home and distant signals, etc. bridge with its devices operated from one location only. The order of operations is given: viz, a warning from which the various designs and types of signaling devices and types of signaling devices for the various drawbridge devices for the various types and also various designs of drawbridges and

To Pass Train Over

*Deraills.* The above example of order of operation includes derailling switches, but their use is not recommended in all cases. Each situation must be given special study with respect to (a) the use of deraills, smash boards or similar devices; (b) their location with respect to drawspan, and (c) the use and length of guard rails.

(e) *Guard Rails.* Guard rails should be provided as for fixed bridges, except for the necessary breaks at the ends of the movable span. Obstructions to derailed wheels which are guided by the guard rails should be reduced to a minimum.

(f) *Rail Attachments.* The rails and attachments should be separated from the metallic structure so track circuits may be successfully operated the entire length of the bridge.

(g) *Bridge Devices.* The various bridge devices should be so designed that R. S. A. interlocking apparatus may be used.

(h) *Locking.* Electric and time locking are regarded as adjuncts.

Design. The above principle of design of approach structures is applied to all cases, but there may be some exceptions in special cases. The design of approach structures should be such that the bridge will be opened to traffic and (2) the use of approach structures will be such that the bridge will be opened to traffic.

(3) *Design of Approach Structures*. The design of approach structures should be such that the bridge will be opened to traffic and (2) the use of approach structures will be such that the bridge will be opened to traffic.

(4) *Rail Attachments*. The rails and attachments should be separated from the metallic structure so track circuits may be successfully operated the entire length of the bridge.

(5) *Interlocking Apparatus*. The various bridge devices should be so designed that R. S. A. interlocking apparatus may be used.

(6) *Signaling*. Electric and time locking are regarded as adjuncts.

THE ILLINOIS STATE ENGINEERING SOCIETY

**CABLES.**

- Aerial Aluminum, Specification.*
- Aerial Braided, for 660 Volts or less, Specification.*
- Armored Submarine, for 660 Volts or less, Specification.*
- Armored Submarine, for 2200 Volts, Specification.*
- Lead Covered, for 660 Volts or less, Specification.*
- Lead Covered, for 2200 Volts, Specification.*
- Underground Braided, for 660 Volts, Specification.*

**CELL.**—See *Battery, Primary.*

**CHANNEL PINS.**—*Specification.*

**CIRCUIT NOMENCLATURE AND WRITTEN CIRCUITS.****CLEARANCE DIAGRAM.****CONCRETE—**

- Box.*—See under *Battery, Storage.*
- Portland Cement, Specification.*

**CONDUIT.**

- Fibre, Specification.*
- Fibre and Metal Installation, Specification.*
- Pipe, Steel, Specification.*
- Pipe, Wrought Iron, Specification.*
- Vitrified Clay, Specification.*
- Vitrified Clay, Installation of a System, Specification.*

**COPPER SULPHATE CRYSTALLIZED.**—*Specification.*

**COPPERS.**—See *Battery, Primary.*

**CROSSARMS.**

- Wood, Specification.*
- Braces and Heel and Toe Bolts for, Specification.*
- Steel Pins for, Specification.*
- Through Bolts and Double-arm Bolts for, Specification.*

**DEFINITIONS FOR TECHNICAL TERMS.**

**ENGINE, GASOLINE, WITH FUEL AND WATER TANKS.**—*Specification.*



REVISIONS FOR TECHNICAL TERMS  
ELECTRIC CABLES WITH FUEL AND WATER TANKS—  
Specification

Through Bolts and Double-arm Bolts for Specification.  
Steel Pins for Specification.  
Braces and Haul and Toe Bolts for Specification.  
WOOD. Specification.

COPERS.—See Battery. Primary.

COPPER ALUMINUM THE BATTERY ALUMINUM SPECIFICATION

Welded Steel Specification  
Wrought Iron, Specification.  
Pipe Steel Specification.

CONDUIT.  
Ribs and Metal Installation. Specification.  
Ribs. Specification.

CLEARANCE DIAGRAM.  
CONCRETE—  
CONCRETE SPECIFICATION

CLEARANCE DIAGRAM.  
CONCRETE SPECIFICATION  
CONCRETE SPECIFICATION

Underground Braid, for 600 Volts, Specification.  
Lead Covered, for 200 Volts, Specification.  
Lead covered for 100 Volts or less, Specification.

Armored Submarine, for 100 Volts or less, Specification.  
Aerial Braid, for 600 Volts or less, Specification.  
Aerial Braid, for 100 Volts or less, Specification.

CABLES

SPECIFICATION FOR AERIAL ALUMINUM CABLE STEEL  
REINFORCED.

1916.

1. *General.*

(a) The intent of these specifications is to provide for the furnishing of aerial aluminum cable steel reinforced.

1916.

(b) The cable shall be composed of one (1) extra high strength galvanized steel wire for a core and six (6) aluminum wires concentrically laid around the steel core.

1916.

(c) The wires composing the cable shall be cylindrical in form, free from scales, flaws, irregularities, splits and all imperfections. Each length shall contain no weld, joint or splice.

1914.

(d) The galvanizing for the steel core shall consist of a continuous coating of pure zinc of uniform thickness so applied that it adheres firmly to the wire and presents a smooth surface.

1914.

2. *Properties.*

(a) The mechanical properties of the separate wires and of the finished cable shall conform to the following requirements:

Complete Cable.

Nominal Size A.W.G.	Diameter Inch	Circular Mils	Elastic Limit Pounds	Breaking Strength Pounds	Approx. Wght. per 1000 feet, Pounds
0000	.564	247275	5950	8452	290.
000	.502	195766	4692	6666	231.
00	.447	155423	3740	5315	184.
0	.398	123118	2964	4215	145.
1	.355	97580	2354	3344	116.
2	.316	77432	1864	2646	91.9
3	.281	61402	1482	2104	72.6
4	.250	48697	1158	1646	57.5
6	.198	30625	732	1040	35.1

# REINFORCED. SPECIFICATION FOR ALUMINUM CABLE STEEL

1916.

1. General.

(a) The intent of these specifications is to provide for the furnishing of aerial aluminum cable steel reinforced.

(b) The cable shall be composed of one (1) extra high strength aluminum steel wire for a 1000 and the 101 aluminum wire concentrically laid around the steel core.

(c) The wires composing the cable shall be cylindrical in form. The four outer wires shall be twisted and all defects shall contain no weld joint or splice.

(d) The steel core shall consist of a continuous length of wire and no welding or splicing shall be permitted in the wire and between the wires.

1. The finished properties of the separate wires and of the finished cable shall conform to the following requirements:

Complete Cable						
Approx. Wt. per 100 feet Pounds	Breaking Strength Pounds	Elastic Limit Pounds	Circular Mil	Diameter Inch	Resistance A w 10	
290.	8452	5950	247275	.564	0000	
291.	6666	4692	195766	.502	000	
181.	1111	1140	111111	.417	00	
145.	445	334	111111	.355	1	
116.	3344	2580	97580	.325	1	
97.5	2104	1482	61402	.281	1	
72.6	1482	1148	42691	.252	1	
57.3	1040	732	30625	.198	1	
35.1						

2. *Properties.—Continued.*

Steel Wire.

Gauge of Complete Cable	Diameter Inch	Circular Mils	Minimum percent Elongation in 18 inches	Elastic Limit Pounds	Breaking Strength Pounds
0000	.1880	35325	4	3600	4450
000	.1670	27966	4	2850	3500
00	.1491	22203	4	2280	2800
0	.1327	17588	4	1800	2240
1	.1182	13940	4	1440	1760
2	.1052	11062	4	1140	1380
3	.0938	8772	4	895	1110
4	.0834	6957	4	720	880
6	.0661	4375	4	450	555

Aluminum Wire.

Gauge of Complete Cable	Diameter Inch.	Circular Mils.	Minimum Percent Elongation in 18 inches	Elastic Limit Pounds	Breaking Strength Pounds.
0000	.1880	35325	1	391	667
000	.1670	27966	1	307	527
00	.1491	22203	1	243	419
0	.1327	17588	1	194	329
1	.1182	13940	1	152	264
2	.1052	11062	1	121	211
3	.0938	8772	1	98	165
4	.0834	6957	1	73	127
6	.0661	4375	1	47	81

1916.

(b) The aluminum wire shall be smooth and true and shall not vary in diameter more than one (1) per cent. from the specified diameter. 1916.

(c) The conductivity of aluminum wire shall be not less than sixty (60) per cent. of Matthiessen's annealed copper standard at 0 degrees C. 1916.

3. *Galvanizing test.*

Galvanizing shall be in accordance with R. S. A. specification. 1916.

4. *Inspection and tests.*

(a) The Purchaser is to have the right to make such inspection and tests of the completed product as are necessary to assure him that the requirements of this specification have been met, except that samples for test

Wires—Continued

Gauge of Complete Cable	Diameter Inch	Circular Mils	Minimum Percent Elongation in 18 inches	Elastic Limit Pounds	Breaking Strength Pounds
0000	.1880	32325	4	3600	4450
000	.1670	27966	4	2850	3500
00	.1491	22203	4	2280	2800
0	.1327	17588	4	1800	2240
1	.1182	13940	4	1440	1760
2	.1052	11062	4	1210	1520
3	.0938	8772	4	895	1110
4	.0834	6957	4	720	880
6	.0661	4375	4	450	555

Gauge of Complete Cable	Diameter Inch	Circular Mils	Minimum Percent Elongation in 18 inches	Elastic Limit Pounds	Breaking Strength Pounds
0000	.1880	32325	1	3600	667
000	.1670	27966	1	307	527
00	.1491	22203	1	254	410
0	.1327	17588	1	194	320
1	.1182	13940	1	152	264
2	.1052	11062	1	121	211
3	.0938	8772	1	98	165
4	.0834	6957	1	73	127
6	.0661	4375	1	47	81

(b) The aluminum wire shall be smooth and true and shall not vary in diameter more than one (1) per cent. from the specified diameter.

(c) The conductivity of aluminum wire shall be not less than 62 per cent. of the conductivity of copper standard at 0 degrees C.

3. Galvanizing test.  
Galvanizing shall be in accordance with R. S. A. specification.

4. Inspection and tests.  
(a) The Purchaser is to have the right to make such inspection and tests of the completed product as are necessary to assure him that the requirements of this specification have been met, except that samples for test



4. *Inspection and tests.*—Continued.

if taken from the finished cable shall not exceed four (4) feet in length and from not more than five (5) per cent. of the reels. 1916.

(b) The Manufacturer must provide, at the mill, all apparatus and labor for making the required tests under the supervision of the Purchaser. 1914.

(c) Tests shall be made at the mill or on samples submitted by the Manufacturer and may also be made on the cable upon its arrival at destination. 1914.

(d) If, upon arrival at destination, the cable does not meet the requirements of this specification, it will be rejected and returned to the Manufacturer, who shall pay all freight charges. 1914.

5. *Packing for shipment.*

(a) The cable shall be furnished in coils or on reels as specified, and of not less than the following lengths unless otherwise specified:

Gauge of Cable.	Preferred Arrangement.	Minimum Length Feet.
0000	Reel	3500
000	"	4400
00	"	5600
0	"	3550
1	Coil	4500
2	"	5600
3	"	3550
4	"	4500
6	"	4100

1916.

(b) When furnished on reels, each reel shall have the weight, length of cable, with arrow indicating direction of unreeling, the name of the Manufacturer, and Purchaser's order and inspection number plainly and indelibly marked on a strong tag securely fastened to the cable and also stenciled on the outside of the reel. 1914.

(c) When furnished in coils, each coil shall be thoroughly wrapped with burlap and shall have the weight, length and size of cable, the name of the maker, the Purchaser's order and inspection number and the proper shipping address plainly and indelibly marked on a strong tag, securely fastened to the coil. 1914.

Section and tests.—Continued.

- (a) If taken from the finished cable shall not exceed four (4) feet in length and from not more than five (5) per cent of the reels.
- (b) The Manufacturer must provide, at the mill, all apparatus and labor for making the required tests under the supervision of the Purchaser.
- (c) Tests shall be made at the mill on samples submitted by the Manufacturer and may also be made on cable upon its arrival at destination.
- (d) If upon arrival at destination the cable does not meet the requirements of this specification, it will be rejected and returned to the Manufacturer, who shall pay all freight charges.

5. Packing for shipment.

- (a) The cable shall be furnished in coils or on reels as specified, and of not less than the following lengths unless otherwise specified.

Length	Weight
1000	0000
500	000
200	00
100	0
50	0
25	1
12.5	2
6.25	3
3.125	4
1.5625	6

- (b) When furnished on reels, each reel shall have the weight, length of cable, and number of strands marked on a tag, securely fastened to the coil.
- (c) When furnished in coils, each coil shall be thoroughly wrapped with hessian and shall have the weight, length and size of cable, the number of strands, and the number of coils marked on a tag, securely fastened to the coil.

SPECIFICATION FOR THE INSTALLATION OF FIBRE  
AND METAL CONDUIT SYSTEMS.

1916.

1. *Purpose.*

The purpose of this specification is to provide for the installation of fibre and metal conduit systems as used in automatic signal work.

2. *Material.*

(a) Fibre conduit shall be in accordance with R. S. A. specification and of the following sizes:

Inside Diameter. Inches.	Thickness of Wall. Inches.
1	$\frac{1}{4}$
$1\frac{1}{2}$	$\frac{1}{4}$
2	$\frac{1}{4}$
$2\frac{1}{2}$	$\frac{1}{4}$
3	$\frac{1}{4}$
$3\frac{1}{2}$	$\frac{1}{4}$
4	$\frac{1}{4}$

(b) Wrought iron pipe conduit shall be in accordance with R. S. A. specification.

(c) Steel pipe conduit shall be in accordance with R. S. A. specification.

(d) Concrete, where used for protection of fibre conduit, shall be in accordance with R. S. A. specification for "Portland Cement Concrete."

(e) Junction box cover castings and conduit reducers shall be in accordance with ..... drawing  
....., dated .....

3. *Drawings.*

Drawings accompanying this specification and forming an essential part thereof, are:

1. Purchaser's drawing ....., dated ....., showing location of tracks and locations where conduit, as per detail location plans, shall be installed.

# SPECIFICATION FOR THE INSTALLATION OF FIBRE AND METAL CONDUIT SYSTEMS

The purpose of this specification is to provide for  
 the installation of fibre and metal conduit systems as used  
 in automatic signal work.

(a) Fibre conduit shall be in accordance with R. S. A.  
 specification and of the following sizes:

Size of Conduit	Weight per Foot
1/4"	1
3/8"	2
1/2"	3
5/8"	3 1/2
3/4"	4

(b) Wrought iron pipe conduit shall be in accordance  
 with R. S. A. specification.

(c) Steel pipe conduit shall be in accordance with  
 R. S. A. specification.

(d) Concrete, where used for protection of fibre con-  
 duit shall be in accordance with R. S. A. specification for

(e) Junction box cover castings and conduit reducers  
 shall be in accordance with ..... drawing  
 ..... dated .....

Drawings accompanying this specification and form-  
 ing an essential part thereof, are:

showing location of tracks and locations where conduit  
 as per detail location plans, shall be installed.

3. *Drawings.—Continued.*

2. .... drawing, dated ....., showing typical arrangement of conduit and fittings for single track location with signal opposite.
3. .... drawing ....., dated ....., showing typical arrangement for double signal location on double track.
4. .... drawing, ....., dated ....., concrete junction box and cover.
5. .... drawing, ....., dated ....., track connections.

4. *Trench.*

- (a) Where fibre conduit is used it shall be placed in a trench of sufficient width to accommodate the conduit and concrete boxing and the work of placing them in position.
- (b) The bottom of the trench shall be free from traps, depressions, humps and other irregularities.
- (c) The minimum grade shall not be less than ten (10) inches in one hundred (100) feet.

5. *Concrete protection.*

- (a) The concrete protection for fibre conduit shall be constructed of well tamped concrete placed into a wooden form, the inside dimensions of which shall be—for

Inches.		Inches.
1	conduit	8x8
1½	"	8x8
2	"	8x8
2½	"	8x8
3	"	10x10
3½	"	10x10
4	"	10x10

- (b) Where conduit is laid under tracks, the tops shall be protected by not less than six (6) inches of well tamped concrete.

6. *Placing conduit.*

- (a) After forms have been built in place, not less than two (2) inches of concrete shall be placed in form to support conduit. Conduit shall then be put in position and firmly fixed to allow form to be filled and tamped.
- (b) Conduit shall be placed in concrete before initial set has taken place.
- (c) The sections of conduit shall be carefully butted, centered and leveled to the proper grade and alignment.



10000000  
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SECTION 10000000  
 SECTION 10000000

3. Drawings—Continued.

(a) Drawings shall show the location of track with signal opposite. (b) Drawings shall show the location of track with signal opposite. (c) Drawings shall show the location of track with signal opposite. (d) Drawings shall show the location of track with signal opposite. (e) Drawings shall show the location of track with signal opposite. (f) Drawings shall show the location of track with signal opposite. (g) Drawings shall show the location of track with signal opposite. (h) Drawings shall show the location of track with signal opposite. (i) Drawings shall show the location of track with signal opposite. (j) Drawings shall show the location of track with signal opposite. (k) Drawings shall show the location of track with signal opposite. (l) Drawings shall show the location of track with signal opposite. (m) Drawings shall show the location of track with signal opposite. (n) Drawings shall show the location of track with signal opposite. (o) Drawings shall show the location of track with signal opposite. (p) Drawings shall show the location of track with signal opposite. (q) Drawings shall show the location of track with signal opposite. (r) Drawings shall show the location of track with signal opposite. (s) Drawings shall show the location of track with signal opposite. (t) Drawings shall show the location of track with signal opposite. (u) Drawings shall show the location of track with signal opposite. (v) Drawings shall show the location of track with signal opposite. (w) Drawings shall show the location of track with signal opposite. (x) Drawings shall show the location of track with signal opposite. (y) Drawings shall show the location of track with signal opposite. (z) Drawings shall show the location of track with signal opposite.

4. Details

(a) Where five conduit is used it shall be placed in a trench of sufficient width to accommodate the conduit and the trench shall be placed in position. (b) The conduit shall be placed in position. (c) The conduit shall be placed in position. (d) The conduit shall be placed in position. (e) The conduit shall be placed in position. (f) The conduit shall be placed in position. (g) The conduit shall be placed in position. (h) The conduit shall be placed in position. (i) The conduit shall be placed in position. (j) The conduit shall be placed in position. (k) The conduit shall be placed in position. (l) The conduit shall be placed in position. (m) The conduit shall be placed in position. (n) The conduit shall be placed in position. (o) The conduit shall be placed in position. (p) The conduit shall be placed in position. (q) The conduit shall be placed in position. (r) The conduit shall be placed in position. (s) The conduit shall be placed in position. (t) The conduit shall be placed in position. (u) The conduit shall be placed in position. (v) The conduit shall be placed in position. (w) The conduit shall be placed in position. (x) The conduit shall be placed in position. (y) The conduit shall be placed in position. (z) The conduit shall be placed in position.

Inches	conduit	Inches
8x8	"	1
8x8	"	1 1/2
8x8	"	2
8x8	"	2 1/2
10x10	"	3
10x10	"	3 1/2
10x10	"	4

(b) Where conduit is laid under tracks, the top shall be protected by not less than six (6) inches of well tamped concrete.

5. Wiring conduit

(a) After laying pipe, conduit shall be placed in position. (b) After laying pipe, conduit shall be placed in position. (c) After laying pipe, conduit shall be placed in position. (d) After laying pipe, conduit shall be placed in position. (e) After laying pipe, conduit shall be placed in position. (f) After laying pipe, conduit shall be placed in position. (g) After laying pipe, conduit shall be placed in position. (h) After laying pipe, conduit shall be placed in position. (i) After laying pipe, conduit shall be placed in position. (j) After laying pipe, conduit shall be placed in position. (k) After laying pipe, conduit shall be placed in position. (l) After laying pipe, conduit shall be placed in position. (m) After laying pipe, conduit shall be placed in position. (n) After laying pipe, conduit shall be placed in position. (o) After laying pipe, conduit shall be placed in position. (p) After laying pipe, conduit shall be placed in position. (q) After laying pipe, conduit shall be placed in position. (r) After laying pipe, conduit shall be placed in position. (s) After laying pipe, conduit shall be placed in position. (t) After laying pipe, conduit shall be placed in position. (u) After laying pipe, conduit shall be placed in position. (v) After laying pipe, conduit shall be placed in position. (w) After laying pipe, conduit shall be placed in position. (x) After laying pipe, conduit shall be placed in position. (y) After laying pipe, conduit shall be placed in position. (z) After laying pipe, conduit shall be placed in position.

6. *Placing conduit.*—Continued.

(d) Where two or more sections of conduit are laid side by side, they shall be separated by at least one (1) inch of cement mortar, and all joints shall be staggered.

(e) A mandrel of the proper size shall be drawn through each duct as the conduit is laid, for the purpose of removing dirt and projections of mortar.

7. *Joints.*

(a) All joints in fibre conduit shall be waterproofed with a covering of suitable compound and wrapped with unbleached cotton, muslin or tarred paper, about three (3) inches wide. The covering shall be dipped in hot compound and quickly wound twice around the joint.

(b) All joints in wrought iron or steel conduit shall be coated with a suitable compound and screwed tightly together.

8. *Junction boxes.*

(a) Junction boxes shall be of concrete with metal cover to comply with ..... drawing ....., dated ..... They shall be located at junctions of fibre and metal conduits to comply with ..... drawings ....., dated .....

(b) Conduit openings shall be not less than four (4) inches above bottom of junction box, as shall be arranged in each case, as required by local conditions.

(c) Top of junction boxes shall be level with base of rail.

9. *Branch lines.*

(a) Branch lines from junction boxes to signal foundations, track, relay boxes or battery boxes, shall be  $\left\{ \begin{array}{l} \text{fibre} \\ \text{steel} \\ \text{iron} \end{array} \right\}$  conduit, of sizes shown on ..... drawings ....., dated .....

(b) All branch lines shall slope toward junction boxes with a minimum grade of not less than ten (10) inches in one hundred (100) feet.

(c) Branch lines of steel or wrought iron conduit shall be laid in bottom of trench in a bed of earth with alignment maintained.

(d) The minimum angle of bend shall be ninety (90) degrees, and the minimum radius of bend shall be thirteen (13) inches.

(e) All ends of steel or wrought iron pipe shall be provided with suitable bushing.

(b) Where two or more sections of conduit are laid side by side they shall be separated by at least one (1) inch of mortar. The mortar shall be applied to the ends of the conduit and the joints shall be covered with a covering of suitable material and worked with a covering of suitable material and worked with a covering of suitable material.

### 7. Joints.

(a) All joints in fibre conduit shall be waterproofed with a covering of suitable material and worked with a covering of suitable material. The covering shall be applied to the ends of the conduit and the joints shall be covered with a covering of suitable material and worked with a covering of suitable material.

### 8. Junction boxes.

(a) Junction boxes shall be of concrete with metal cover to comply with drawing dated . . . . . They shall be located at junctions of fibre and metal conduit in accordance with drawing dated . . . . .

(b) Junction boxes shall be of concrete with metal cover to comply with drawing dated . . . . . They shall be located at junctions of fibre and metal conduit in accordance with drawing dated . . . . .

(c) Top of junction boxes shall be level with base of rail.

### 9. Branch lines.

(a) Branch lines from junction boxes to signal foundations, track, relay boxes or battery boxes, shall be of fibre, steel or iron conduit of sizes shown on drawings dated . . . . .

(b) All branch lines shall slope toward junction boxes with a minimum grade of not less than ten (10) inches in one hundred (100) feet.

(c) Branch lines of steel or wrought iron conduit shall be laid in bottom of trench in such a manner that the minimum angle of bend shall be ninety (90) degrees and the minimum radius of bend shall be twenty (20) inches.

(e) All ends of steel or wrought iron pipe shall be provided with suitable bushing.

10. *Track connections.*

Track connections shall be arranged to comply with  
..... drawing .....

11. *Plugging ducts.*

When the work is left at night and at other times, also  
after the conduit system has been completed, all duct  
holes shall be firmly plugged with wooden plugs.

12. *Refilling trench.*

After conduit has been laid and concrete has set, the  
trench shall be refilled and shall be well tamped while re-  
filling.

Track connections.

Track connections shall be arranged to comply with  
drawing .....

Working hours.

When the work is left at night and at other times also  
after the conduit system has been completed, all duct  
holes shall be neatly plugged with wooden plugs.

12. Working trench.

After conduit has been laid and concrete has set, the  
trench shall be refilled and shall be well rammed while re-  
grading.

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**FIBRE, HARD.**—*Specification.*

**FORMS.**—*See Performance of Recording Signal.*

**FUSES.**—*Specification.*

**GALVANIZING FOR IRON OR STEEL.**—*Specification. (Am. Ry. Eng. Ass'n.)*

**GENERAL PROVISIONS OF SIGNAL INSTALLATIONS.**—*Specifications.*

**GENERATORS.**

*A.C. Electric, Specification.*

*D.C. Electric, Specification.*

**IMPEDANCE BONDS.**

*11,000 Volts, A.C. Propulsion, Specification.*

*D.C. Propulsion, Specification.*

*Petrolatum for Use in, Specification.*

**IMPREGNATION TREATMENT OF COILS AND WINDINGS.**—*Specification.*

**INDICATORS.**—*See Switch Indicators, or Take Siding Indicator.*

**INDICATIONS, SIGNAL, PRINCIPLES OF.**

**INSTRUCTIONS.**

*Testing and Maintaining Dry Cells.*

*Maintenance of Gravity Cells.*

*Maintenance of Caustic Soda Cells.*

**INTERLOCKING.**

*Electric, Specifications.*

*Electromechanical, Specifications.*

*Electropneumatic, Specifications.*

*Mechanical, Specifications.*

**IRON.**

*Castings, Gray, Specification.*

*Malleable, Specification.*

*Wrought Bars, Specification.*

**LAMPS.**—*Incandescent Electric, Specification.*

**LIGHTNING PROTECTION.**

*Arresters, Requisites for.*

*Choke Coils, Requisites for.*

*Vacuum Gap, Specification.*



GENERAL PROVISIONS OF SPECIFICATIONS FOR  
SIGNAL INSTALLATIONS.

1916.

1. *Purpose.*

(a) The purpose of these specifications is to provide  
for ..... 1915.

(b) These specifications describe the materials to be  
furnished, work to be performed and method of construc-  
tion for a complete installation in every detail, in strict  
accordance with the drawings and specifications men-  
tioned herein, and such instructions as may, from time to  
time, be given by the Purchaser; and it is hereby under-  
stood that the Contractor agrees to furnish any and every  
thing obviously necessary for such complete installation,  
except that specifically stated as being furnished by the  
Purchaser. .... 1915.

2. *Details of work.\**

.....  
.....  
..... 1916.

3. *Detail specifications.*

Detail specifications referred to herein and forming an  
essential part hereof are as follows:.....  
.....  
..... 1915.

4. *Drawings.*

(a) Purchaser's drawings. Drawings accompanying the  
specifications and forming an essential part thereof are as  
follows:

1. Drawing ....., dated ....., scale  
one (1) inch, equals ..... (..) feet, showing  
the arrangement of tracks, grades, curvature, the  
location of interlocking stations, power stations,

---

\*The Purchaser will here describe, in detail, the  
work that is to be installed, changes, if any, that are to  
be made and what portions, if any, of an existing installa-  
tion, are to be removed. This information will be supple-  
mentary to that of the general plan and should be such as  
to enable the Contractor to get a clear idea of the extent  
and details of the work. .... 1916.



4. Drawings. (a)—Continued.

trunking lines, pipe lines, air reservoirs, valves, location, numbering, type, arm travel and control (R. S. A. symbols) of existing and proposed signals, location and numbering of switches, derails, switch mechanisms, detector bars, interlocking machines, steam and electric railway crossings, highway crossings, highway crossing alarms, track circuit limits, trestles, stations, station platforms, pole line or other supports for line wires or aerial cables, approximate number of poles per mile, average distance of nearest pole from each signal or relay box to which line wire connections are required, notations showing the sections of rail and drilling of rail joints, and such other information as is desirable. 1916.

2. Drawing ....., dated ....., showing typical circuits for the control of power operated signals, switch indicators, protection for facing and trailing switches, main-line and siding crossovers, highway crossing alarms, train order signals and ..... 1911.

3. Drawing ....., dated ....., showing typical circuits for approach locking, route locking, track circuits and the control of annunciators, indicators, repeaters, and ..... 1911.

4. Drawing ....., dated ....., showing locations of battery housings, junction posts and ..... for typical signal and relay locations. 1915.

5. Standard and other drawings..... 1915.

(b) Contractor's drawings.

1. The Contractor shall furnish, with his proposal, drawings or catalogue references for the apparatus he proposes to furnish, which is not covered by the drawings furnished by the Purchaser. 1911.

2. Not more than ..... (..) days after the award of the contract, and before work is begun, the Contractor shall furnish, for the approval of the Purchaser, the following drawings:

.....  
.....  
Not more than ..... (..) days after the re-



(2) - **Drawings**  
 trunking lines, pipe lines, air reservoirs, valves, low  
 tion, numbering, type, arm travel and control (R. S. A.  
 symbols) of existing and proposed lines, valves, etc.  
 and showing the location of existing and proposed lines,  
 valves, etc.  
 The drawings shall show the location of existing and proposed  
 stations, station distance, pole line or other sup-  
 ports for line wires or aerial cables, approximate  
 number of poles per mile, average distance of poles  
 pole from each signal or relay box to which the wires  
 connections are required, notations showing the loca-  
 tions of rail and bridge of rail joints, and such other  
 information as is desirable.

1. Drawing dated .....  
 showing typical circuits for the control of power  
 operated signals, switch indicators, protection for  
 and limiting switches, main line and siding  
 covered highway crossing of main line and siding.

4. Drawing dated .....  
 showing locations of battery housings, junction boxes  
 and ..... for typical signal and relay loca-  
 tions.  
 5. Standard and other drawings.  
 1912

(b) Contractor's drawings.  
 1. The Contractor shall furnish, with his proposal,  
 drawings or catalogue references for the apparatus  
 he proposes to furnish, which is not covered by the  
 drawings furnished by the Purchaser.  
 2. Not more than ..... ( ) days after the  
 award of the contract and before work is begun, the  
 Contractor shall furnish for the approval of the Pu-  
 chaser, the following drawings:  
 .....  
 .....  
 Not more than ..... ( ) days after the re-

4. *Drawings.* (b-2)—Continued.

ceipt of these drawings the Purchaser will indicate any corrections that may be necessary or signify his approval. 1915.

(c) After the contract is awarded each party shall furnish to the other necessary prints of his approved drawings. 1911.

(d) Framed manipulation chart and track diagram shall be furnished in place by the ..... 1915.

5. *Proposals.*

(a) With his proposal the Contractor shall submit supplemental specifications, stating his interpretation of the specification requirements. 1916.

(b) The proposals must meet the requirements of the specifications; however, if a bidder wishes to vary from the specifications or drawings, an alternative proposal may be submitted. Full information must be furnished with the alternative proposal to show wherein the requirements of these specifications are not met. 1911.

6. *Contract.*

As soon as practicable after the award is made .....  
..... (..) copies of the contract, in accordance with the accompanying form, will be presented to the Contractor for signature, after which all copies will be signed by the Purchaser and one will be returned to the Contractor. 1915.

7. *Changes and additions.*

(a) Changes and additions, as provided for in the contract, shall be made in accordance with these specifications. 1911.

(b) Additional work within the scope of the contract shall be done on the basis of the unit prices as stated in the contract. 1911.

8. ....  
.....  
.....  
.....

9. *Material and workmanship.*

(a) Material and workmanship shall be first class in every respect. 1911.

(a) Material and workmanship shall be first class in every respect.

(b) Additional work within the scope of the contract shall be done on the basis of the unit prices as stated in the contract.

(c) Changes and additions shall be made in accordance with these specifications.

(d) Changes and additions, as provided for in the contract, shall be made in accordance with these specifications.

Contractor shall submit for the review of the Engineer, as soon as practicable, three copies of the contract, in accordance with the accompanying form, which shall be presented to the Contractor for signature, after which all copies will be signed by the Purchaser and one will be returned to the Contractor.

(b) The proposal must meet the requirements of the specifications; however, if a higher value is shown in the specifications or drawings, an alternative proposal may be submitted. Full information must be furnished with the alternative proposal to show whether the requirements of the specifications are met.

(c) With his proposal the Contractor shall submit supplemental specifications, stating his interpretation of the specifications.

(d) Framed manipulation sheet and last diagram shall be furnished in place by the Contractor.

(e) After the contract is awarded each party shall be bound to the other necessary terms of his approved drawings.

(f) After the contract is awarded each party shall be bound to the other necessary terms of his approved drawings.

(g) After the contract is awarded each party shall be bound to the other necessary terms of his approved drawings.

9. *Material and workmanship.—Continued.*

(b) The Contractor shall replace, at his own cost, any part or parts of the apparatus and material furnished by him, which shall, within a period of one (1) year from date of acceptance of the installation, fail to perform its proper function because of any defect in the design, construction, application or erection of such apparatus.

1915.

10. *Furnished by the Purchaser.*

(a) The Purchaser will furnish material and labor on items in Section 10 (c) as follows:

- |                             |       |
|-----------------------------|-------|
| 1. Material only .....      | 1915. |
| 2. Labor only .....         | 1915. |
| 3. Material and labor ..... | 1915. |

(b) The Purchaser will furnish the items indicated above, subject to the inspection and direction of the Contractor, who shall assume full responsibility for the proper performance of the work. The intent of this paragraph is to bar any claim by the Contractor that the work done by the Purchaser has not been performed in such manner as to enable him to fulfill all of the provisions of the contract.

1915.

(c) *Items.*

- |  |       |
|--|-------|
| 1. Ties for support of apparatus.                | 1915. |
| 2. Move ties as may be necessary.                | 1915. |
| 3. Move switch and tie rods as may be necessary. | 1915. |
| 4. Rail insulations.                             | 1915. |
| 5. Bridge insulations.                           | 1915. |
| 6. Switch-rod insulations.                       | 1915. |
| 7. Tie-rod insulations.                          | 1915. |
| 8. Tie-plate insulations.                        | 1915. |
| 9. Sand, stone and cement.                       | 1915. |
| 10. Necessary grading and drainage.              | 1915. |
| 11. Excavation of solid rock.                    | 1915. |
| 12. Poles for line wire.                         | 1915. |
| 13. Cross arms, pins and insulators.             | 1915. |
| 14. Line wire.                                   | 1915. |
| 15. Battery wells.                               | 1915. |
| 16. Signal bridges.                              | 1915. |
| 17. Aerial cable.                                | 1915. |
| 18. Submarine cable.                             | 1915. |

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10. *Furnished by the Purchaser. (c)—Continued.*

19. Apply necessary attachments to signal apparatus in service. 1915.
20. Make necessary alterations of any part of existing structures or apparatus. 1915.
21. Unload and properly house material that arrives on the ground before the Contractor's force; this work to be done under the supervision of the Contractor's representative. 1916.
22. Distribute material. 1915.
23. Obtain necessary permits from Federal, State and Municipal authorities. 1915.
24. Switches, derails and movable point frogs of the required throw. 1915.
25. Tools, fixtures for buildings and supplies required for the maintenance of the plant. 1915.
26. Rail braces, except those located on tie plates installed by the Contractor. 1915.
27. Remove obstructions to permit the installation of detector bars. 1915.
28. Submarine air pipe line. 1915.
29. Transportation. 1915.
30. Prior to installation, furnish stakes establishing grade of track at points where pipe lines are to be run. 1916.

11. *Inspection of material.*

Material at any time before installation shall be subject to the inspection of the Purchaser's accredited representative. 1911.

12. *Shipment of material.*

Material shall be shipped to ....., care of ....., marked for ..... Material shipped from Contractor's factory at ....., shall be shipped via ..... and thence via ..... to destination. 1911.

13. *Transportation.*

(a) The Purchaser { will } furnish transportation for men, necessary for the installation, over the following lines .....  
..... 1915.

1. Name of the  
2. Address  
3. City  
4. State  
5. Zip

NEW YORK SIGNAL ASSOCIATION

Furnished by the Purchaser. (7)---Continued.

20. Make necessary alterations of any part of existing structure or apparatus. 1915.  
21. Change and properly house material that is stored on the ground before the Contractor's forces; this work to be done under the supervision of the Contractor's representative. 1915.

22. Excavated, dewatered and provide proper drainage for the required ditches. 1915.  
23. Provide for building and equipment required for the maintenance of the ditches. 1915.

24. Rail bridge (structure) and located on the right of way. 1915.

25. Submarine air pipe line. 1915.  
26. Transportation. 1915.  
27. Prior to installation, furnish service establishment grade of track to permit where piping lines are to be run. 1915.

Material at any time before installation shall be subject to the inspection of the Purchaser's representative. 1915.

Material shall be shipped to the site of the project in accordance with the contract. Material shipped from Contractor's factory at [blank] and thence via [blank] to destination. 1915.

Transportation.  
(a) The Purchaser { will }  
{ will not } furnish transportation for material necessary for the installation, over the following lines: 1915.

13. *Transportation.—Continued.*

(b) The Purchaser  $\left\{ \begin{array}{l} \text{will} \\ \text{will not} \end{array} \right\}$  furnish transportation for tools and material, necessary for the installation, over the following lines..... 1915.

14. *Supervision.*

The installation shall be made under the supervision and to the satisfaction of the Purchaser's accredited representative. 1915.

15. *Inspection of installation.*

The Contractor shall advise the Purchaser ..... (..) days in advance of the time the installation will be completed and ready for final inspection. The Purchaser will make inspection and tests within ..... (..) days after the completion of the work. 1915.

16. *Precautions.*

(a) The Contractor shall place sufficient and proper guards for the prevention of accidents, and shall put up and maintain, at night, suitable and sufficient lights. 1911.

(b) The Contractor shall do no work that may interfere with traffic until protection has been provided by the Purchaser. 1911.

(c) The Purchaser will promptly arrange to protect traffic upon request of the Contractor. 1911.

17. *Use of hand and other cars.*

(a) The use of the following cars will be permitted when regulations for their operation are made a part of these specifications:

	Number	Furnished by
Motor cars.....	..... (..)	.....
Velocipede cars..	..... (..)	.....
Hand cars.....	..... (..)	.....
Push cars .....	..... (..)	.....

1914.

(b) When the Contractor is not permitted to use cars, the Purchaser will distribute material, under the supervision of the Contractor's representative. 1916.

18. *Tests.*

The Contractor shall make such tests as may be necessary to demonstrate, to the satisfaction of the Purchaser, that the apparatus, as installed, is in accordance with the requirements of the specifications and contract. The Contractor shall provide such instruments and apparatus

13. Transportation.—Continued.

(a) The Contractor will furnish transportation for tools and material necessary for the installation over the following lines: .....

14. Supervision.

The installation shall be made under the supervision and to the satisfaction of the Purchaser's representative.

15. Inspection of installation.

The Contractor shall advise the Purchaser ( ) days in advance of the time the installation will be completed and ready for final inspection. The Purchaser will make inspection and tests within ( ) days after the completion of the work.

16. Precautions.

(a) The Contractor shall place suitable and proper guards for the prevention of accidents and shall put up suitable and proper signs and lights.

(b) The Contractor shall do no work that may interfere with the operation of the existing signal system.

17. Use of hand and other cars.

(a) The use of hand and other cars shall be subject to the approval of the Contractor.

Number	Furnished by
Motor cars	.....
Velocipede cars	.....
Hand cars	.....
Push cars	.....

(b) When the Contractor is not permitted to use the Purchaser's hand and other cars, the Contractor shall make such arrangements as may be necessary to demonstrate to the satisfaction of the Purchaser that the installation is in accordance with the specifications and standards.

The Contractor shall make such arrangements as may be necessary to demonstrate to the satisfaction of the Purchaser that the installation is in accordance with the specifications and standards.

18. *Tests.—Continued.*

as may be necessary for making the tests. The instruments and apparatus shall remain the property of the Contractor. 1916.

19. *Placing in service.*

(a) After receipt of written authority from the Purchaser, the Contractor shall place the installation in service under the supervision of the Purchaser, and shall leave ..... (..) competent men on duty for ..... (..) days thereafter. 1911.

(b) The Purchaser will place the installation in service in the event that he does not authorize the Contractor to do so within ..... (..) days after the completion of the work to the Purchaser's satisfaction. 1915.

(c) Signal aspects shall be displayed or changed only as authorized by the Purchaser. 1916.

20. *Completion.*

When the installation is completed, the apparatus and the surface of the ground which has been affected by the installation, shall be left in a neat and clean condition. 1911.



as may be necessary for making the tests. The instru-  
ments and apparatus shall remain the property of the  
Contractor.

1. During in service.

(a) After receipt of written notification from the Pur-  
chaser, the Contractor shall place the installation in ser-  
vice under the supervision of the Purchaser, and shall  
leave a competent man on duty for  
... days thereafter.

(b) The Purchaser will place the installation in service  
in the event that he does not authorize the Contractor to  
do so within ... days after the completion  
of the work to the Purchaser's satisfaction.

(c) Signal apparatus shall be displayed or changed only  
as authorized by the Purchaser.

When the installation is completed, the apparatus and  
the signal which has been altered by the  
Contractor shall be returned to the Purchaser.

## PRINCIPLES OF SIGNAL INDICATIONS.

1912.

(a) On all high signals conferring or restricting rights a red light shall be the night indication for STOP. A yellow light shall be the night indication for CAUTION, and a green light the night indication for PROCEED.

*Note.*—The word caution to be used as indicating the function of a distant signal.

(b) The day aspects of semaphore signals shall be formed by positions of the arm or arms in one of the upper quadrants. 1916.

(c) The semaphore arm in the horizontal position shall indicate STOP, inclined upward forty-five (45) degrees, CAUTION, and inclined upward, ninety (90) degrees, PROCEED.

CHAPTER 10. SIGNALS AND LIGHTS

101.

On all high signals, the word "STOP" shall be illuminated in red light. A yellow light shall be used for the night indication of "CAUTION".

The word "CAUTION" shall be used as indicating the function of the signal.

(b) The day aspects of semaphore signals shall be formed by positions of the arm or arms in one of the upper quadrants.

(c) The semaphore arm in the horizontal position shall indicate "STOP".

## SWITCH INDICATORS.

1916.

### PURPOSES

1. Switch indicators are recognized as an adjunct of the automatic block system. They may be arranged to indicate one or more of the following:

- 1-a. Whether or not a train is approaching.
- 1-b. Whether or not that portion of the block between the switch and the next Home Block Signal in advance is clear.
- 1-c. Whether or not the next Home Block Signal in the direction of approaching train is at Stop.

2. In a system equipped with switch indicators, indicators are unnecessary, and may therefore be omitted, at certain switches where signals are so located and controlled that the indications which would be given by the switch indicators can be obtained from the aspects of the signals.

### REQUISITES OF INSTALLATION

1. Switch indicators located preferably:

1-a. At main-track switches connected with tracks on which trains may clear main tracks and in which either there are no derails or diverging switches, or the derails or diverging switches are connected with the main-track switches.

1-b. At independently operated derails or diverging switches in tracks on which trains may clear main tracks.

1-c. At points from which switches of crossovers between main tracks are operated, or locked, where both switches are operated or locked from the same point.

1-d. At independently operated switches of crossovers between main tracks, the indicator at the switch in one track operated in connection with the other track.

2. A switch indicator for each direction where indications relating to traffic in both directions on the same track are to be given.

3. Switch indicators that cannot be identified by their locations, marked with the designations of the tracks or the directions of traffic in connection with which they are operated.

block system. They may be arranged to indicate one or more of the

- 1-a. Whether or not a train is approaching.
- 1-b. Whether or not a train is in the block.
- 1-c. Whether or not a train is in the block.
- 1-d. Whether or not a train is in the block.

At points from which switches of crossers are operated or locked, where both switches are operated or locked from the same point.

At points from which switches of crossers are operated or locked, where both switches are operated or locked from the same point.

At points from which switches of crossers are operated or locked, where both switches are operated or locked from the same point.

A switch indicator for each direction where indications refer to traffic in both directions on the same track are to be given.



4-a. The connections of switch indicators used to indicate whether or not a train is approaching, so arranged that an indicator will indicate the approach of a train that has reached a point at least such a distance in the rear of the second block signal in the direction of approaching trains that, if the switch is thrown at the moment when a train reaches that point, the Caution-signal will be displayed in time to be observed by the engineman; and will continue so to indicate until the train passes the Home Block Signal in the rear of the switch or, approximately, the clearance point of the switch when the switch is more than ..... feet in advance of the Home Block Signal. The distance of the point at which the approach of a train is first indicated will be determined in each case by the grade, speed of trains, view of the signal or other local conditions.

4-b. Equivalent control of signals certain aspects of which serve, in lieu of switch indicators, to indicate whether or not a train is approaching.

The connections of switch indicators used to indicate whether a train is approaching, as arranged that an indicator will indicate the approach of a train that has reached a point at least equal to the distance of the second block signal in the direction of the approaching train; if the switch is thrown in the moment when a train reaches that point, the indicator will be displayed in time to be observed by the engineer; and will continue so to indicate until the train passes the Home Block Signal. In the case of a switch not approached, the clearance point of the switch when the switch is more than ... last indicator of the Home Block Signal. The distance of the point at which the approach of a train is first indicated will be determined by the distance of the switch from the point of view of the signal of other local conditions.

4-b. Independent control of signals, certain aspects of which are in line of switch indicators, to indicate whether or not a train is approaching.

UNIVERSITY OF ILLINOIS

## SPECIFICATIONS FOR ELECTRIC INTERLOCKING

1911.

Revised 1916.

To be installed at.....  
on the..... R.....

### INDEX.

	Section.
Annunciators .....	630
Arresters, lightning .....	635
boxes .....	722
Batteries, isolated .....	550 to 600
signal and line .....	556
track .....	550
Battery chutes .....	725
coppers .....	554
Battery, gravity, copper sulphate.....	553
jars .....	551
wells .....	728
storage .....	85
zincs .....	552
Blades, signal .....	415
Bolts, signal foundation .....	271
Bonding .....	540 to 550
wires .....	540
Bootlegs .....	708
Boxes, junction .....	710
cable .....	718
lightning arrester .....	722
relay .....	720
Bracket and bridge signals.....	403
Bracket signals .....	402
Buildings .....	50 to 60
foundations .....	50
painting .....	840
Cable boxes .....	718
Case, machine .....	105
Channel pins .....	542
Chutes, battery .....	725

1797

Revised 10-6

	Section.
Circuits .....	500 to 520
cross protection .....	505
electric lighting .....	506
practice .....	500
signal .....	504
special .....	510
switch .....	503
track .....	502
switchboard .....	501
Common return .....	526
Concrete .....	280
Conduits .....	711
Control apparatus .....	600 to 700
Controllers, circuit .....	610
Coppers, gravity battery .....	554
Copper sulphate .....	553
Detail provisions .....	50 to 950
Detector bars .....	340 to 348
Driving pieces .....	344
Electric lighting circuits .....	506
locks .....	615
releases .....	618
Electrical requirements .....	30
Engine .....	61
Fibre, insulating .....	748
Foundation bolts, signal .....	271
Foundations .....	270
building .....	50
Fuses .....	528
General provisions (See unit specification).	
Generator .....	65
Ground signals .....	401
Hand releases .....	618
Housing for gasoline tank .....	53
Indication .....	103
Indicators .....	625
Instrument and battery shelters .....	720 to 735
Insulated rail joints .....	735
Insulating fibre .....	748
Insulations .....	735 to 800
pipe line .....	742
switch rod .....	738
tie plate .....	744
Interlocking machine .....	100 to 271
station .....	51





	Section.
Iron work, painting .....	810
Jars, gravity battery .....	551
Joints in wire .....	527
rail, insulated .....	735
trunking .....	703
Junction boxes .....	710
Junction terminals .....	928
Lamps .....	430
Lamp boxes .....	431
Levers .....	102
Lighting .....	54
Lightning arrester boxes .....	722
arresters .....	635
Line construction .....	714
Line supports .....	715
Locations, signal .....	435
Locking .....	101
Lock rods .....	312
Locks .....	925
electric .....	615
time .....	622
Machine, interlocking .....	100
painting .....	820
Mechanical connections .....	301
Motor .....	70
Motor generator .....	75
Number plates .....	926
Paint .....	800
Painting .....	800 to 900
buildings .....	840
iron work .....	810
machine .....	820
wod work .....	830
Petroleum asphaltum .....	532
Pins, channel .....	542
Pipe line insulation .....	742
Plant .....	60
Power house .....	52
supply .....	60 to 98
Rail clips .....	342
joints, insulated .....	735
Relays .....	600
boxes .....	720
cases .....	721
Releases, hand .....	618
time .....	619



	Section.
Rocking shafts and fittings.....	345
Roundels .....	425
Section locking circuits.....	348
Signal, arm shafts.....	420
blades .....	415
circuits .....	504
locations .....	435
Signals .....	400 to 500
bracket .....	402
dwarf .....	405
ground .....	401
Special circuits .....	510
items .....	900 to 950
Spectacles, semaphore .....	410
Stops and guides .....	343
Storage battery .....	85
Supports, line .....	715
trunking .....	705
Switches .....	300 to 340
Switch circuits .....	503
mechanism .....	300
rod insulations .....	738
Switchboards .....	90
Tags .....	530
Terminal board .....	104
Tie plate insulations .....	744
Time lock .....	622
releases .....	619
Track batteries .....	550
circuits .....	502
Transformers .....	80
Trunking .....	700
conduit and supports.....	700 to 720
supports .....	705
joints .....	703
Type and assembly of signals.....	400
Wells, battery .....	725
Wire and wiring.....	520 to 540
joints .....	527
sizes .....	521
specifications .....	520
Wiring .....	525
Wood work, painting .....	830
Zinc, gravity battery .....	552

no. 1038



## SPECIFICATIONS FOR ELECTRIC INTERLOCKING.

1911.  
Revised 1916.

### GENERAL PROVISIONS OF SPECIFICATIONS FOR SIGNAL INSTALLATIONS.

(See unit specification covering the text of these provisions indexed  
under Subdivision G.)

*Note.*—This unit specification has been adopted as of January 10, 1917, to take the place of the "General Provisions," heretofore forming a part of these specifications. This sheet is numbered 1 to 5, in order to obviate the necessity of having the existing subject matter reprinted.

SPECIFICATION FOR INTERLOCKING

1917  
Revised 1916

GENERAL PROVISIONS OF SPECIFICATIONS FOR  
INTERLOCKING

This specification covering the text of these provisions indexes  
the following sections (G.)

When this specification is used in connection with the  
specification for the construction of interlocking  
apparatus, the following provisions shall be observed:  
1. The construction of interlocking apparatus shall be in  
accordance with the provisions of this specification and  
the specification for the construction of interlocking  
apparatus.

*GENERAL ELECTRIC REQUIREMENTS.*

30. *General electric requirements.*

(a) Electric apparatus shall withstand an insulation test at the place of manufacture of three thousand (3,000) volts a.c. for one (1) minute. 1911.

(b) Magnets and solenoids shall be plainly marked with their resistance and the size of wire with which they are wound. 1911.

(c) Windings shall be treated in accordance with R. S. A. specifications for "Impregnation Treatment for Coils and Windings." 1916.

*DETAIL PROVISIONS.*

BUILDINGS

50. *Foundations.*

(a) Foundations shall be provided by the ..... in accordance with specifications and drawings ..... dated ..... 1916.

(b) The foundation for interlocking station leadout supports shall be furnished in place by the ..... in accordance with R. S. A. drawings 1200, 1203, or 1217. 1916.

51. *Interlocking station.*

Building shall be provided by the ..... in accordance with specifications and drawings ..... dated ..... 1916.

52. *Power house.*

Building shall be provided by the ..... in accordance with specifications and drawings ..... dated ..... 1916.

54. *Lighting.*

(a) The lighting for buildings shall be installed by ..... 1911.

(b) The type of fixtures, number, kind, size and switch control of electric lamps shall be in accordance with .... specifications and drawings ..... dated .....; lamps distributed as follows:

	Number.	Watts per Lamp.
Operating room	..... (..)	..... (..)
Tower room	..... (..)	..... (..)
Battery room	..... (..)	..... (..)
Generator room	..... (..)	..... (..)
Special	..... (..)	..... (..)
		1916.



54. *Lighting.*—Continued.

(c) Fixtures for electric lighting shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

(d) Fixtures and accessories for electric lamps shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

POWER SUPPLY

60. *Plant.\**

(a) The power plant shall consist of .....  
 ..... 1916.

(b) .....  
 shall be furnished by ..... and installed  
 by ..... 1916.

(c) .....  
 shall be furnished by ..... and installed  
 by ..... 1916.

61. *Engine.*

(a) A ..... (..) cylinder ..... (..)  
 cycle  $\left\{ \begin{array}{l} \text{vertical} \\ \text{horizontal} \\ \text{turbine} \end{array} \right\} \left\{ \begin{array}{l} \text{steam} \\ \text{air} \end{array} \right\}$  engine of ..... (..)  
 brake horse-power, manufactured by ....., in-  
 stalled by ....., the ..... shall be fur-  
 nished on a ..... foundation, to be furnished in  
 place by the ....., constructed in accordance  
 with the standard specifications of the ..... and  
 drawings of the Manufacturer of the engine numbers  
 ....., dated ..... 1916.

(b) Gasoline engines, fuel and water tanks shall conform to R. S. A. specification. 1916.

(c) Engines shall be of such type as to be easily accessible for attention to bearings, adjusting and cleaning. 1916.

(d) Contractor shall furnish sufficient material for installation of muffler outside of building with as few turns and bends as practicable. 1916.

(e) A complete set of wrenches shall be furnished. 1911.

(f) Exposed piping subject to excessive heat shall be protected with  $\left\{ \begin{array}{l} \text{asbestos} \\ \text{.....} \end{array} \right\}$  covering. 1916.

\*R. S. A. drawings 1388 and 1389 may be used as guides in determining the parts of each plant, which may then be specified in Section 60.



6101

feet of bar (equally spaced) and not less than two (2) such stops on one (1) bar. 1911.

### Material.

(a) Driving pieces shall be wrought iron or steel, arranged for one and eleven-thirty-seconds ( $1\frac{11}{32}$ ) inch jaw connections. The part where the jaw is connected shall be three-fourths by two by three ( $\frac{3}{4} \times 2 \times 3$ ) inches, and part riveted to bar shall be one-half by two by six ( $\frac{1}{2} \times 2 \times 6$ ) inches, drilled for three (3) one-half ( $\frac{1}{2}$ ) inch rivets one (1) inch from end and two (2) inches between centers of holes. Offset from bar to jaw connection shall be one and one-half ( $1\frac{1}{2}$ ) inches. 1911.

(b) Driving pieces shall be placed midway between two (2) clips in space not occupied by joint in bar, and the driving rod shall have a length of not more than seven (7) feet unsupported.

*Material.*

(a) Rocking shafts shall be made of two (2) inch square rolled steel with movable bearings and movable crank arms. Arms shall be wrought iron nine (9) inches center to center.

(b) Rocking shaft bearings shall be made of cast iron and fastened to a one by three by twenty-four (1x3x24) inches wrought iron or steel bearer drilled at each end for two (2) three-fourths ( $\frac{3}{4}$ ) inch bolts; the center of first hole shall be two (2) inches from ends and holes shall be spaced three (3) inches between centers. 1911.

(c) Rocking shaft bearers shall be securely bolted to ties with four (4) three-fourths ( $\frac{3}{4}$ ) inch bolts. The maximum spacing of bearers shall be six (6) feet centers.

1911.

Section locking circuits will ..... be required  
in { addition to } detector bars. 1911.  
    { lieu of }

## SIGNALS

(a) Signals shall be of the semaphore type with arm travel ..... (..) degrees in the .....  
 { right }  
 { left } quadrant. 1916.

RAILWAY STATION (KARACHI)

of the railway station, and the station is situated on the right bank of the river.

RAILWAY STATION

When the line is completed, the station will be situated on the right bank of the river, and the station will be situated on the right bank of the river.

When the line is completed, the station will be situated on the right bank of the river, and the station will be situated on the right bank of the river.

RAILWAY STATION

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THE LIBRARY

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When the line is completed, the station will be situated on the right bank of the river, and the station will be situated on the right bank of the river.

400. *Typs and assembly.—Continued.*

(b) The type of signals (as shown by R. S. A. symbols) and location of signals shall be in accordance with ..... drawing ..... 1916.

(c) Signals and fittings shall conform to R. S. A. material specifications. 1916.

(d) The spacing of arms on all masts shall be in accordance with R. S. A. drawings 1035 or 1037. 1916.

(e) Signals shall be mechanically locked in the horizontal position of the arm except as otherwise specified. 1911.

(f) Motors shall be of sufficient capacity and mechanism constructed to perform complete operation of a ninety (90) degree, three (3) position signal when not more than ..... (..) feet from interlocking machine, in not more than ..... (..) seconds with battery at ten (10) per cent. below normal voltage. The normal voltage of battery is one hundred and ten (110) volts. Fair working conditions consist of a distance of thirty-five hundred (3500) feet from interlocking machine and seven (7) seconds time of complete operation. 1911.

401. *Ground signals.*

The general design, dimensions and structure shall be in accordance with R. S. A. drawing 1035. 1916.

402. *Bracket signal posts.*

(a) Bracket signal posts of pipe shall be made of .... (..) inch and ..... (..) inch wrought iron pipe with water-tight joints, mounted in R. S. A. base drawing 1038. 1916.

(b) Top of crosstrees shall be ..... (..) feet ..... (..) inches above base of bracket post. 1911.

(c) Bracket signal posts of channel column construction shall be in accordance with R. S. A. drawing 1032. 1916.

403. *Bracket and bridge signal masts.*

Bracket and bridge signal masts shall be made of five (5) inch wrought iron pipe, mounted in R. S. A. base drawing 1036. 1916.

405. *Dwarf signals.*

(a) Dwarf signals shall be of { cast  
wrought } iron and shall not be more than ..... (..) feet ..... (..) inches from base to center of the bearing. 1916.





521. *Size. (f)—Continued.*

	No. of conductors	B. & S. gauge.
1. Track batteries to rail..	one (1)	..... (..)
2. Relays to rail.....	one (1)	..... (..)
3. Foulingshuntconnections	two (2)	..... (..)
4. Switch circuit controller connections .....	two (2)	..... (..)
5. Wire from trunking to track batteries in chutes, stranded .....		..... (..)

1911.

(g) Wires connected to track shall be rubber-covered  
 soft-drawn copper. 1911.

525. *Wiring.*

(a) Wires in trunking, chases or conduits shall be laid  
 loosely without stretching or crowding. 1911.

(b) Not more than two (2) wires shall be connected to  
 one (1) binding post or terminal screw. 1911.

(c) Unless otherwise specified, all wires shall be run  
 as separate conductors. 1911.

526. *Common return.*

(a) Reductions in size of common wire and connec-  
 tions to pole lines shall be made in junction boxes. 1911.

(b) Connections between branches and main common  
 wires shall be made in junction boxes. 1911.

(c) Unless otherwise specified, common return wires  
 shall be continuous without joints or breaks from inter-  
 locking machine to the limits of the interlocking plant. 1911.

527. *Joints in wire.*

(a) Wires shall, as far as practicable, be continuous  
 without joints or breaks between interlocking machine  
 and the unit operated; joints when made shall be in junc-  
 tion boxes, and only made on permission from the Engi-  
 neer. 1911.

(b) In making joints, braid shall be pulled back one  
 (1) inch from end of rubber on each side of splice, and  
 rubber cut with knife held at an angle of approximately  
 thirty (30) degrees with axis of wire, as one would  
 sharpen a pencil. 1911.

(c) After removing rubber, wire shall be thoroughly  
 cleaned, care being taken to prevent injury from small  
 cuts or nicks. 1911.

2 in wire.—Continued

(b) Wire after being cleaned, shall be twisted together in the form of a regular line wire spiral, turns being spaced approximately one-sixty-fourth (1/64) inch.

(c) Joints shall then be soldered by pouring on them or dipping them into molten solder a non-corrosive flux being used. After soldering, joints shall be covered with two (2) layers of rubber-insulating tape between ends of pairs, which tape shall be heated sufficiently to form a tight covering, but not enough to injure the quality of the material; insulating tape shall be in accordance with the R. S. A. specification for "Rubber Insulating Tape". Two (2) layers of fabric tape shall be applied over the rubber insulation and the ends of the twisting, and this tape shall then be thoroughly coated with black waterproofing paint. This insulation shall be in accordance with the R. S. A. specification for "Rubber Insulating Tape".

(d) The finished wire shall be of the twisted type, in accordance with the R. S. A. specification for "Twisted Wire".

(e) The twisted wire shall be of the twisted type, in accordance with the R. S. A. specification for "Twisted Wire".

(f) The twisted wire shall be of the twisted type, in accordance with the R. S. A. specification for "Twisted Wire".

(g) The twisted wire shall be of the twisted type, in accordance with the R. S. A. specification for "Twisted Wire".

(h) The twisted wire shall be of the twisted type, in accordance with the R. S. A. specification for "Twisted Wire".

(i) The twisted wire shall be of the twisted type, in accordance with the R. S. A. specification for "Twisted Wire".

(j) The twisted wire shall be of the twisted type, in accordance with the R. S. A. specification for "Twisted Wire".

(k) The twisted wire shall be of the twisted type, in accordance with the R. S. A. specification for "Twisted Wire".

(l) The twisted wire shall be of the twisted type, in accordance with the R. S. A. specification for "Twisted Wire".

(m) The twisted wire shall be of the twisted type, in accordance with the R. S. A. specification for "Twisted Wire".

830. *Wood work.*

Exposed wood work shall be given one (1) priming coat and finishing coats as follows:

	Kind of paint	Color	Number of coats
Home signal blades	.....	.....	.....(..)
Dwarf signal blades	.....	.....	.....(..)
Distant signal blades	.....	.....	.....(..)
Trunking, junction boxes, etc.	.....	.....	.....(..)
Foundation tops and bottoms	.....	.....	.....(..)
			1911.

840. *Buildings.*

Interlocking station and other buildings, if constructed of wood, shall receive one (1) priming coat and two (2) finishing coats. The priming coat shall consist of ..... and, when thoroughly dry, two (2) coats of ..... in the following tints, shall be applied:

.....  
 .....  
 .....  
 .....  
 style="text-align: right;">1911.

SPECIAL ITEMS

900.

.....  
 .....  
 .....  
 style="text-align: right;">1911.

925. *Locks.*

Purchaser's standard locks shall be used where specified. style="text-align: right;">1911.

926. *Number plates and numbers.*

(a) Number plates.

.....  
 .....  
 .....  
 style="text-align: right;">1911.

(b) Numbers.

.....  
 .....  
 .....  
 style="text-align: right;">1911.

928. *Junction terminals.*

Junction terminals shall be in accordance with R. S. A. drawing 1056. style="text-align: right;">1916.



SPECIFICATIONS FOR ELECTROMECHANICAL  
INTERLOCKING.

1916.

To be installed at .....  
on the ..... R.....

INDEX.

	Section.
Adjustments, pipe (See leadout and groundwork) .....	235
Annunciators (See control apparatus).....	630
Arrestors, lightning (See control apparatus).....	635
Assembly, type and (See signals).....	400
Auxiliary circuit controllers (See interlocking machine).....	107
Bars, detector (See detector bars).....	340
Bars, deflecting (See leadout and groundwork).....	203
Batteries, signal and line control (See isolated battery).....	552
Batteries, track (See isolated battery).....	551
Battery chutes (See instrument and battery shelters).....	725
Battery, isolated .....	550 to 600
signal and line control.....	552
track .....	551
type of .....	550
Battery, storage (See power supply).....	85
Battery wells and boxes (See instrument and battery shelters) ..	728
Bolt locks (See switch connections).....	313
Bolt screws and washers (See leadout and groundwork).....	261
Bolts, signal foundation (See foundations).....	271
Bonding wires (See bonding).....	540
Bonding .....	540 to 550
bonding wires .....	540
channel pins .....	542
Bootlegs (See trunking, conduit and supports).....	708
Braces, rail (See switch connections).....	322
Buildings .....	50 to 60
foundations .....	50
interlocking station .....	51
lighting .....	54
power house .....	52
Cable boxes (See instrument and battery shelters).....	718
Carriers, pipe (See leadout and groundwork).....	213
Case (See interlocking machine).....	105





	Section.
Channel pins (See bonding).....	542
Chutes, battery (See instrument and battery shelters).....	725
Circuits .....	500 to 520
cross protection .....	505
electric lighting .....	506
home signal control .....	504
practice .....	500
special .....	510
switchboard .....	501
switch indicating .....	503
track .....	502
Circuit controllers (See control apparatus).....	610
Circuits, section locking (See detector bars).....	348
Common return (See wire and wiring).....	526
Compensators (See leadout and groundwork).....	220
Concrete (See foundations).....	280
Conduits (See trunking, conduits and supports).....	711
Control apparatus .....	600 to 700
annunciators .....	630
circuit controllers .....	610
electric locks .....	615
indicators .....	625
lightning arresters .....	635
relays .....	600
releases .....	618
time releases .....	619
Controllers, auxiliary circuit (See interlocking machine).....	107
Cranks (See leadout and groundwork).....	202
Cross protection circuits (See circuits).....	505
Detector bars .....	340 to 400
detector bars .....	340
section locking circuits.....	348
Deflecting bars (See leadout and groundwork).....	203
Electric lighting circuits (See circuits).....	506
Electric locks (See control apparatus).....	615
Engine (See power supply).....	61
Facing point locks (See switch connections).....	310
Foundations .....	270 to 300
bolts, signal foundations.....	271
boxing .....	290
concrete .....	280
foundations .....	270
Foundations (See buildings).....	50
Fuses (See wire and wiring).....	528
Gauge, butt and riser plates (See switch connections).....	320



	Section.
Gauge plate insulation (See insulation).....	744
Generator (See power supply).....	65
Groundwork, leadout and (See leadout).....	200 and 270
Home signal control (See circuits).....	504
House, power (See buildings).....	52
Indications (See interlocking machine).....	103
Indicators (See interlocking machine).....	106
Indicators (See control apparatus).....	625
Instrument and battery shelters.....	718 to 735
battery chutes .....	725
battery wells and boxes.....	728
cable boxes .....	718
lightning arrester boxes.....	722
relay boxes .....	720
relay cases .....	721
Insulations .....	735 to 748
gauge plate insulation.....	744
insulated rail joint.....	735
insulating fibre .....	748
pipe line insulations.....	742
switch rod insulations.....	738
Interlocking machine .....	100 to 200
case .....	105
controllers, auxiliary circuit .....	107
indicators .....	106
levers .....	102
locking .....	101
machine .....	100
terminal board .....	104
Interlocking station (See buildings).....	51
Jaws and lugs (See leadout and groundwork).....	230
Joints in trunking (See trunking, conduit, etc.).....	703
Joints in wire (See wire and wiring) .....	527
Junction boxes (See trunking, conduit, etc.).....	710
Lamps (See signals) .....	430
Leadout and groundwork.....	200 to 270
bolts, screws and washers.....	261
compensators .....	220
cranks .....	202
deflecting bars .....	203
jaws and lugs .....	230
leadout .....	200
pins .....	260
pipe adjustments .....	235
pipe and pipe lines.....	210

Section

700	Water insulation (See insulation)
701	or (See power supply)
702	Work lead and (See lead)
703	Heat control (See control)
704	See (See power supply)
705	ations (See interlocking machine)
706	ators (See interlocking machine)
707	ators (See control apparatus)
708 to 709	Interlocking and battery shutoff
710	Battery wells and boxes
711	
712	See power supply
713	See power supply
714 to 715	See power supply
716	See power supply
717	See power supply
718	See power supply
719	See power supply
720	See power supply
721	See power supply
722	See power supply
723	See power supply
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789	See power supply
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791	See power supply
792	See power supply
793	See power supply
794	See power supply
795	See power supply
796	See power supply
797	See power supply
798	See power supply
799	See power supply
800	See power supply



Leadout and groundwork.—Continued.	Section.
pipe carriers .....	213
locking shafts and fittings.....	206
stuffing boxes .....	212
Levers (See interlocking machine).....	102
Lighting (See buildings).....	54
Lightning arresters (See control apparatus).....	625
Lightning arrester boxes (See instrument and battery shelters) .	722
Line construction (See trunking, conduit, etc.).....	714
Lines, pipe and pipe (See leadout and groundwork).....	210
Locking (See interlocking machine).....	101
Locks .....	925
Locks, bolt (See switch connections).....	313
Locks, electric (See control apparatus).....	615
Locks, facing point (See switch connections).....	310
Lock rods (See switch connections).....	312
Lugs and jaws (See leadout and groundwork).....	230
Machine (See interlocking machine).....	100
Mechanical connections (See switch connections).....	301
Mechanism, switch (See switch connections).....	300
Mercury arc rectifier (See power supply).....	81
Motor (See power supply).....	70
Motor generator (See power supply).....	75
Number plates and numbers.....	926
Painting .....	800
Petroleum asphaltum (See wire and wiring).....	532
Pins (See leadout and groundwork).....	260
Pipe adjustments (See leadout and groundwork).....	235
Pipe and pipe lines (See leadout and groundwork).....	210
Pipe carriers (See leadout and groundwork) .....	213
Pipe line insulations (See insulation).....	742
Plant (See power supply).....	60
Plates, gauge, butt and riser (See switch connetions).....	320
Power house (See buildings).....	52
Power supply .....	60 to 100
engine .....	61
generator .....	65
mercury arc rectifier .....	81
motor .....	70
motor generators .....	75
power plant .....	60
storage battery .....	85
switchboards and equipment .....	90
transformers .....	80
Practice (See circuits) .....	500
Rail braces (See switch connections).....	322

# RAILWAY SIGNalling

1	General
2	Signal and groundwork
3	Signal and groundwork
4	Signal and groundwork
5	Signal and groundwork
6	Signal and groundwork
7	Signal and groundwork
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91	Signal and groundwork
92	Signal and groundwork
93	Signal and groundwork
94	Signal and groundwork
95	Signal and groundwork
96	Signal and groundwork
97	Signal and groundwork
98	Signal and groundwork
99	Signal and groundwork
100	Signal and groundwork

	Section.
Rectifier, mercury arc (See power supply).....	81
Relays (See control apparatus).....	600
Relay boxes (See instrument and battery shelters).....	720
Relay cases (See instrument and battery shelters).....	721
Releases (see control apparatus).....	618
Releases, time (See control apparatus).....	619
Rocking shafts and fittings (See leadout and groundwork).....	206
Rods, lock (See switch connections).....	312
Roundels (See signals).....	425
Section locking circuits (See detector bars).....	348
Signals .....	400 to 500
lamps .....	430
roundels .....	425
type and assembly .....	400
Signal and line control batteries (See isolated battery).....	552
Size (See wire and wiring).....	521
Special circuits (See circuits).....	510
Specifications (See wire and wiring).....	520
Station, interlocking (See buildings).....	51
Storage battery (See power supply).....	85
Straps, tie (See switch connections).....	330
Stuffing boxes (See leadout and groundwork).....	212
Supports, trunking (See trunking, etc.).....	705
Switch connections .....	300 to 340
bolt locks .....	313
facing point locks .....	310
gauge, butt and riser plates.....	320
lock rods .....	312
mechanical connections .....	301
rail braces .....	322
switch mechanism .....	300
tie straps .....	330
Switchboard circuits (See circuits).....	501
Switchboards and equipment (See power supply).....	90
Switch indicating circuits (See circuits).....	503
Switch mechanism (See switch connections).....	300
Switch rod insulations (See insulations).....	738
Tags (see wire and wiring).....	530
Terminal board (See interlocking machine).....	104
Tie straps (See switch connections).....	330
Time releases (See control apparatus).....	619
Track batteries (See isolated battery).....	551
Track circuits (See circuits).....	502
Transformers (See power supply).....	80
Trunking .....	700



	Section.
Trunking, conduit and supports.....	700 to 718
bootlegs .....	708
conduits .....	711
joints in trunking.....	703
junction boxes .....	710
line construction .....	714
line supports .....	715
trunking .....	700
trunking supports .....	705
Type and assembly (See signals).....	400
Type of battery (See isolated battery).....	550
Wire and wiring .....	520 to 540
common return .....	526
fuses .....	528
joints in wire.....	527
petroleum asphaltum .....	532
size .....	521
specifications .....	520
tags .....	530
wiring .....	525
Wires, bonding (see bonding).....	540
Wiring (See wire and wiring).....	525





SPECIFICATIONS FOR ELECTROMECHANICAL  
INTERLOCKING.

1916.

GENERAL ELECTRICAL REQUIREMENTS

DETAIL PROVISIONS.

BUILDINGS

50. *Foundations.*

(a) Foundations shall be provided by the .....  
in accordance with specifications and drawings .....  
dated ..... 1916.

(b) The foundation for interlocking station leadout  
supports shall be furnished in place by the .....  
in accordance with R. S. A. drawings 1200, 1203 or 1217.  
1916.

51. *Interlocking station.*

Building shall be provided by the ..... in ac-  
cordance with specifications and drawings .....  
dated ..... 1916.

52. *Power house.*

Building shall be provided by the ..... in ac-  
cordance with specifications and drawings .....  
dated ..... 1916.

INTERLOCKING.

DETAIL PROVISIONS.

(a) Foundations shall be provided by the .....  
in accordance with specifications and drawings .....  
dated ..... 1916.

(b) The .....  
supports shall be furnished in place by the .....  
in accordance with R. S. A. drawings nos. 202 or 207.  
1916.

(c) Interlocking station.  
Buildings shall be provided by the ..... in ac-  
cordance with specifications and drawings .....  
1916.

(d) Power house.  
Buildings shall be provided by the ..... in ac-  
cordance with specifications and drawings .....  
dated ..... 1916.

(a) The lighting for buildings shall be installed by .....

	Number.	Watts per Lamp.
Operating room	..... (.)	..... (.)
Tower room	..... (.)	..... (.)
Battery room	..... (.)	..... (.)
Generator room	..... (.)	..... (.)
Special	..... (.)	..... (.)

1916.

(d) Fixtures and accessories for electric lamps shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities.

(a) The power plant shall consist of .....  
1916.

(b) .....  
shall be furnished by ..... and installed by .....  
..... 1916.

(c) .....  
shall be furnished by ..... and installed by .....  
..... 1916.

(a) A ..... (..) cylinder ..... (..)  
 cycle { vertical } { steam } engine of ..... (..)  
       { horizontal } { air }  
       { turbine }  
 brake horse-power, manufactured by .....  
 installed by ..... the .....

\*R. S. A. drawings 1388 and 1389 may be used as guides in determining the parts of each plant, which may then be specified in Section 60.





61. *Engine.* (a)—Continued.

shall be furnished on a ..... foundation, to be furnished in place by the ....., constructed in accordance with the standard specifications of the ..... and drawings of the Manufacturer of the engine numbers ....., dated ..... 1916.

(b) Gasoline engine, fuel and water tanks shall conform to R. S. A. specification. 1916.

(c) Engine shall be of such type as to be easily accessible for attention to bearings, adjusting and cleaning. 1916.

(d) Contractor shall furnish sufficient material for installation of muffler outside of building with as few turns and bends as practicable. 1916.

(e) A complete set of wrenches shall be furnished. 1911.

(f) Exposed piping subject to excessive heat shall be protected with { asbestos } covering. 1916.

65. *Generator.*

The electric generator shall be in accordance with R. S. A. specification. 1916.

70. *Motor.*

The motor shall be ..... (..) kilowatt approximate equivalent ..... (..) h.p. with a rated speed not to exceed ..... (..) r.p.m., if direct current, or one thousand eight hundred (1800) r.p.m., if alternating current, and shall have automatic regulation to within ..... (..) per cent. when operating on ..... (..) to ..... (..) volts d.c., or on ..... (..) to ..... (..) volts, ..... (..) cycles ..... phase a.c., shall be in accordance with R. S. A. specification for "Electric Generators" regarding heating, sparking and insulation, and shall be furnished with a starting panel. 1916.

75. *Motor generators.*

Motor generators shall be ..... connected, mounted on a cast iron sub-base and shall conform to R. S. A. specification (Sections 65 and 70). 1916.

80. *Transformers.*

Transformers shall conform to { R. S. A. } specification. 1916.

61. Engine. (a) —Continued.  
shall be furnished on a ..... foundation to be  
furnished in place by the ..... consumed  
in accordance with the standard specifications of the  
and drawings of the Manufacturer of

(b) Gasoline engine, fuel and water tanks shall conform to R. S. A. specification.  
(c) Engine shall be of such type as to be easily accessible for attention to bearings, adjusting and cleaning.  
(d) Contractor shall furnish sufficient material for installation of muffler outside of building with an row turns and bands as practicable.  
(e) A complete set of wrenches shall be furnished.

III Exposed piping subject to excessive heat shall be covered.

The motor shall be ..... (.) follow approx-  
imate ..... (.) h.p. with a rated  
speed not to exceed ..... (.) r.p.m. It direct  
current or one thousand eight hundred (1800) r.p.m. It direct  
alternating current and shall have automatic regulation  
to within ..... (.) per cent when operating on  
..... (.) to ..... (.) volts  
or on ..... (.) to ..... (.) volts  
..... (.) cycles ..... (.) phase, etc.  
shall be in accordance with R. S. A. specification for  
"Electric Generators" regarding bearing, sealing and  
insulation, and shall be furnished with a starting switch.

75. Motor generators.  
mounted on a cast iron sub-base and shall conform to  
R. S. A. specification (Sections 65 and 70).

80. Transformers.  
Transformers shall conform to R. S. A. specification.

81. *Mercury arc rectifier.*

Mercury arc rectifier shall conform to  
 { R. S. A. drawing 1242 }  
 { ..... } and shall be of .....  
 (...) d.c. ampere capacity, with d.c. voltage regulation be-  
 tween ..... (..) and ..... (..) volts.  
 Rectifier shall be designed to be operated from a single  
 phase a.c. supply of ..... (..) volts and .....  
 ..... (..) cycles without over-heating and causing  
 permanent deterioration of its insulation when operated  
 at maximum capacity. 1915.

85. *Storage battery.*

(a) Storage batteries shall consist of ..... (..) cells ..... (..) ampere hour capacity of the  
 { lead  
 { nickel, iron, alkaline } type and shall conform to the  
 R. S. A. standard specification. 1915.

(b) Lead type storage battery shall be in accordance with R. S. A. drawings 1224, 1241, 1340 and 1341. 1916.

(c) The installation of storage batteries shall conform to directions of R. S. A. covering installation of storage batteries. 1916.

(d) For each plant where lead type batteries are used one (1) hydrometer, one (1) thermometer and two (2) extra jars shall be provided by the ..... 1915.

(e) The battery rack shall be furnished in place by the ..... and shall conform to ..... drawing ..... 1915.

(f) The initial charge shall be conducted by the ..... and shall be in accordance with the Manufacturer's instructions. 1915.

(g) The ..... shall provide current at the proper voltage for the initial charge. 1911.

90. *Switchboards and equipment.*

Switchboards and equipment shall conform to R. S. A. specification and be in accordance with R. S. A. drawings 1174, 1240, 1243 and 1244. 1916.

INTERLOCKING MACHINE

100. *Machine.*

(a) Levers shall be numbered and arranged in accordance with drawing ..... dated ..... 1915.

(b) Like parts of machine of same type shall be interchangeable. 1914.

(c) All bolts, tap bolts and set screws shall be provided with jam nuts or nut locks where it is practicable to apply them. 1914.





100. *Machine.*—Continued.

(d) One lever shoe pin and cap shall be provided for each spare space. 1911.

(e) One (1) mechanical lever shall not operate more than:

1. One (1) mechanical signal.
2. Two (2) pairs of switch points.
3. Two (2) full length detector bars.
4. Two (2) switch and lock movements and one (1) full length detector bar.
5. Two (2) eight (8) way mechanical bridge couplers.

6. The combination of all rail locks, bridge locks, mechanical bridge couplers and electric bridge couplers when the total load of such combination exceeds the load of two (2) eight (8) way mechanical bridge couplers. 1914.

101. *Locking.*

(a) Machine shall be provided with mechanical locking of the preliminary type. 1911.

(b) For each lever and each spare space, depending upon the type of machine, provision shall be made in the locking bed for space to accommodate either:

1. One (1) locking shaft with one (1) cross locking bar and one (1) longitudinal locking bar for the full length of the machine. 1916.

2. One (1) tappet with one (1) longitudinal locking bar for the full length of the machine. 1916.

(c) Locking shall be distributed as uniformly as possible in the locking bed and so arranged as to be easily accessible. 1911.

(d) Each end of locking shafts of Saxby & Farmer type shall be square and of like dimensions. 1914.

(e) The front, back and intermediate rails supporting locking bed of Saxby & Farmer type shall be provided with one-way caps. 1911.

(f) Locking shall be so arranged that it can be operated by electric levers, or mechanical levers, or both. 1916.

102. *Levers.*

(a) Levers shall be numbered from left to right. On machines having two and one-half ( $2\frac{1}{2}$ ) inch spacing of electric levers the electric levers shall be given even numbers and the mechanical levers odd numbers, starting



# Railway Signal Association.

(b) One lever shoe pin and cap shall be provided for

(c) One (1) mechanical lever shall not operate more

1. One (1) mechanical signal.
2. Two (2) pairs of switch points.
3. Two (2) full length detector bars.
4. Two (2) switch and lock movement and one (1) full length detector bar.
5. Two (2) right (8) way mechanical bridge.

6. The combination of all rail locks, bridge locks, mechanical bridge couplers and electric bridge couplers when the total load of such combination exceeds the load of two (2) right (8) way mechanical bridge couplers.

(a) Machine shall be provided with mechanical locking of the preliminary type.

(b) For each lever and each spare space, depending upon the (a) machine provision shall be made in the locking to accommodate either

length of the machine.  
1. One (1) tapset with one (1) longitudinal locking bar for the full length of the machine.

(c) Locking shall be distributed as uniformly as possible in the locking bed and so arranged as to be easily accessible.

(d) Each end of locking shafts of Gandy & Farmer type shall be square and of like dimensions.

(e) The front back and intermediate rails supporting locking bed of Gandy & Farmer type shall be provided with one-way caps.

(f) Locking shall be so arranged that it can be operated by electric levers or mechanical levers or both.

(a) Levers shall be numbered from left to right. On machines having two and one-half (2½) inch spacing of electric levers the electric levers shall be given even numbers and the mechanical levers odd numbers, starting

102. *Levers.* (a)—Continued.

with 1 and omitting every other odd number.

2 4 6 8 10 12 14 Electric levers.

1 5 9 13 Mechanical levers.

On machines having five (5) inch spacing of electric levers the electric levers shall be given even numbers and the mechanical levers odd numbers.

2 4 6 Electric levers.

1 3 5 7 Mechanical levers. 1916.

(b) Levers shall be arranged so that they can be removed without interfering with other levers. 1911.

(c) Spare levers, as specified under Section 100, shall be furnished in place complete, ready for operation and control of their respective units. 1911.

(d) Mechanical levers shall be provided with normal and reverse latches. Adequate means shall be provided to prevent accidental displacement of electric levers. 1916.

(e) Mechanical levers of Saxby & Farmer type machine shall be five feet ten and one-eighth ( $5\frac{10}{8}$ ) inches from center of fulcrum to end of handle. 1916.

(f) In machines of the same type, all mechanical levers shall have equal and uniform throw and be so arranged that connections may be made to front or back of lever. 1916.

(g) Tail levers for pipe connections shall be drilled to provide for eight and three-fourths ( $8\frac{3}{4}$ ), nine and three-fourths ( $9\frac{3}{4}$ ) and ten and three-fourths ( $10\frac{3}{4}$ ) inch stroke. 1916.

(h) Provision  $\left\{ \begin{array}{l} \text{shall} \\ \text{shall not} \end{array} \right\}$  be made for adding a counterweight of ..... (..) foot pounds torque on mechanical switch levers which will assist in moving lever to normal position. 1916.

103. *Indications.*

(a) Each indicating lock lever and each lever for power operated switches, derails, movable point frogs or crossing bars shall be provided with a device to insure the locking of the units in the position corresponding to the position of the lever before the release of the mechanical locking can be effected. 1916.

(b) Each lever for power operated signals shall be provided with a device to prevent the release of the mechanical locking until after the signal arms directly or indirectly controlled have resumed the normal position. 1916.

(c) Levers shall be free to move between their indicating positions. 1911.

with 1 and omitting every other odd number.

2 4 6 8 10 12 14 Electric levers.

1 3 5 7 9 11 Mechanical levers.

On machines having five (5) inch spacing of electric levers the electric levers shall be given even numbers and the mechanical levers odd numbers.

2 4 6 8 Electric levers.

1 3 5 7 Mechanical levers.

(b) Levers shall be arranged so that they can be to

(c) Spare levers as specified under Section 100, shall be furnished in place complete, ready for operation and control of their respective units.

(d) Mechanical levers shall be provided with normal and reverse factors. Adequate means shall be provided to prevent a change in placement of electric levers.

(e) Mechanical levers of Sandy & Palmer type machine shall be five feet ten and one-eighth (5' 10 1/8) inches in length and center of fulcrum to end of handle.

(f) Levers of the same type, all mechanical levers shall be of equal and uniform throw and be so arranged that they be made to front or back of lever.

(g) Test levers for pipe connections shall be drilled to provide for eight and three-fourths (8 3/4), nine and three-fourths (9 3/4), and ten and three-fourths (10 3/4) inch stroke.

(h) Provision shall be made for adding a counterweight of ... foot pounds torque on mechanical switch levers which will assist in moving lever to normal position.

(i) Each indicating rock lever and each lever for power operated switches, details movable parts of cross-rod bars shall be provided with a device to insure the locking of the rods in the position corresponding to the position of the lever and a free release of the mechanism, locking can be effected.

(j) Each lever for power operated signals shall be provided with a device to prevent the release of the mechanical locking until after the signal arms directly or indirectly controlled have returned the normal position.

(k) Levers shall be free to move between their limit

104. *Terminal board.*

Machine shall be provided with terminals or binding posts for making all connections leading from the machine. 1915.

105. *Case.*

Machine shall be enclosed in a case which shall be in accordance with plan ....., dated ....., and provided with Purchaser's standard locks. 1916.

106. *Indicators.*

(a) Each switch lever equipped for electric locking  
 { shall }  
 { shall not } be provided with a visual indicator to indicate whether or not the track circuits controlling the lever are occupied. 1916.

(b) Each signal lever controlling semi-automatic signals { shall }  
 { shall not } be provided with a visual indicator to indicate whether or not the track circuits controlling the signals are occupied. 1916.

(c) Visual indicators for special purposes shall be provided as follows:..... 1916.

(d) Indicators shall be so arranged that they will be visible to the signalman when he is operating the machine. 1916.

107. *Auxiliary circuit controllers.*

Each signal lever controlling semi-automatic signals and one or more signals used to permit movements into occupied blocks { shall }  
 { shall not } be provided with an auxiliary circuit controller arranged for operation as follows: ..... 1916.

LEADOUT AND GROUNDWORK

200. *Leadout.*

(a) Leadout shall be

{ Rocking shaft.  
 Horizontal and vertical crank.  
 Deflecting bar.  
 Deflecting bar and vertical crank. } 1911.

(b) Down rods shall be made of one and one-half (1½) inch { steel }  
 { wrought iron } pipe with standard one and one-fourth (1¼) inch jaws. 1914.

Machine shall be provided with terminals or leads  
posts for making all connections leading from the  
machine.  
1916.

Machine shall be enclosed in a case which shall be in  
accordance with plan and specifications and  
and provided with Paterson's standard locks.  
1916.

#### Indicators

(a) Each switch lever equipped for electric locking

shall be provided with a lock indicator to

show whether or not the lock circuit controlling the  
lever is occupied.  
1916.

(b) Each signal lever controlling automatic signals

shall be provided with a visual indicator to

indicate whether or not the track circuit controlling the  
signals are occupied.  
1916.

(c) Each lever for special purposes shall be pro-

vided with a lock indicator to show when it is

occupied. When he is operating the machine.  
1916.

Each signal lever controlling automatic signals

and one or more signals used as automatic movements shall

be provided with an in-

terlocking circuit arranged for operation as follows:

1916.

(a) Lockout shall be

(1) horizontal and vertical crank.

(2) horizontal and vertical crank.

(3) horizontal and vertical crank.

(b) Lockout shall be made of one and one-half (1 1/2)

inch diameter with standard one and one-

half (1 1/2) inch diameter.



200. *Leadout.—Continued.*

*Field work.*

(c) Down rods shall be vertical with offset jaws, so that they may be connected to levers for either eight and three-fourths ( $8\frac{3}{4}$ ) inch, or nine and three-fourths ( $9\frac{3}{4}$ ) inch stroke. 1916.

(d) Leadout appliances shall be securely fastened to leadout supports with three-fourths ( $\frac{3}{4}$ ) inch bolts, with bolt heads underneath. 1914.

202. *Cranks.*

*Material.*

(a) Vertical cranks shall be in accordance with R. S. A. drawings 1007, 1066 and 1067. 1916.

(b) Horizontal cranks shall be in accordance with R. S. A. drawings 1007, 1008 and 1393. 1916.

*Field work.*

(c) Cranks for main pipe lines shall be drilled eleven and three-fourths ( $11\frac{3}{4}$ ) by eleven and three-fourths ( $11\frac{3}{4}$ ) inch centers, and not more than one (1) crank shall be mounted on the same pin. 1916.

203. *Deflecting bars.*

*Material.*

(a) Vertical deflecting bars shall be in accordance with R. S. A. drawings 1068 and 1069. 1916.

(b) Horizontal deflecting bars shall be of the one-way multiple unit type and shall be in accordance with R. S. A. drawing 1069. 1916.

206. *Rocking shafts and fittings.*

*Material.*

(a) Rocking shafts and fittings shall be in accordance with R. S. A. drawing 1060, 1061 and 1063. 1916.

*Field work.*

(b) Rocking shafts shall be supported by a bearing at each end and not more than six (6) feet of shaft shall be unsupported. 1911.

(c) Rocking shaft bearings shall be securely bolted to foundations with four (4) three-fourths ( $\frac{3}{4}$ ) inch bolts. 1916.

210. *Pipe and pipe lines.*

*Material.*

(a) One (1) inch  $\left\{ \begin{array}{l} \text{steel} \\ \text{wrought iron} \end{array} \right\}$  pipe, couplings, plugs and rivets shall conform to R. S. A. specification and drawing 1015. 1916.

200. Leadout--Continued.

Field work.

- (c) Down rods shall be vertical with offset jaws so that they may be connected to levers for either eight and three-fourths (8 3/4) inch, or nine and three-fourths (9 3/4) inch stroke.
- (d) Leadout appliances shall be securely fastened to lead heads underneath.

Material.

- (a) Vertical cranks shall be in accordance with R. S. A. drawings reg. 1008 and 1009.
- (b) Horizontal cranks shall be in accordance with R. S. A. drawings reg. 1008 and 1009.

Field work.

- (c) Cranks for main pipe lines shall be filled closed and three-fourths (3/4) in diameter and three-fourths (3/4) in length, and not more than one (1) in diameter shall be mounted on the same pin.

201. Detecting apparatus.

Material.

- (a) Detecting apparatus shall be in accordance with R. S. A. drawings reg. 1010 and 1011.
- (b) Horizontal detecting rods shall be of the one way multiple type and shall be in accordance with R. S. A. drawing reg. 1010.

202. Rocking shafts and fittings.

Material.

- (a) Rocking shafts and fittings shall be in accordance with R. S. A. drawing reg. 1012 and 1013.

Field work.

- (b) Rocking shafts shall be supported by a bearing at each end and not more than six (6) feet of shaft shall be unsupported.
- (c) Bearings shall be securely bolted to foundations with four (4) three-fourths (3/4) inch bolts.

203. Type and size of rivets.

Material.

- (a) Rivets shall conform to R. S. A. specification.

210. *Pipe and pipe lines.*—Continued.

(b) One inch pipe shall be used for connections to switches, derails, movable wing and point frogs, detector bars, locks, bridge couplers and ..... signals. Where solid connections are required one and eleven thirty-seconds ( $1\frac{11}{32}$ ) inch round iron shall be used, unless otherwise specified. 1914.

*Field work.*

(c) Pipe lines shall be in true alignment, with nearest pipe not less than four (4) feet six (6) inches from gauge line, except where authority to deviate is granted by the Purchaser. On drawbridges and approaches they shall be kept as far from gauge line as conditions will permit. 1916.

(d) Where practicable, pipes in main line shall be run so that they will lead off on track side in regular order. 1911.

(e) Top of pipe carrier foundations in main pipe line shall be one-eighth ( $\frac{1}{8}$ ) inch below base of rail where conditions will permit. 1911.

(f) Cranks and compensators in main pipe run shall be so located as to leave field side clear for trunking and additional pipe lines. 1916.

(g) Pipe lines shall be laid two and three-fourths ( $2\frac{3}{4}$ ) inch centers and shall be supported on pipe carriers placed not more than eight (8) feet centers on tangents, and on curves of two (2) degrees or more they shall be spaced not more than seven (7) feet centers. 1916.

(h) With the lever in the center position of stroke, the couplings in pipe line shall be located not less than twelve (12) inches from pipe carriers. 1916.

(i) Where so specified, "T" beam track supports shall be used where pipe lines cross under tracks, and construction shall be in accordance with ..... drawing ....., dated ....., and shall be furnished in place by Purchaser. 1911.

(j) Pipe lines running under tracks shall be arranged to permit standard spacing and proper tamping of ties, except where otherwise provided. 1911.

(k) Turns in pipe lines shall be made with deflecting bars, radial arms or cranks as follows:

(b) One inch pipe shall be used for connections to switches, details, movable and joint traps, detectors

### Field work

(c) Pipe lines shall be in true alignment, with nearest pipe not less than four (4) feet six (6) inches from gutter line, except where authority to deviate is granted by the Purchaser. On drawbridges and approaches they shall be level as the floor slabs and as conditions will permit.

(d) Where parallel pipe in main line shall be run so that they will read off on the side in running order.

(e) Top of pipe carrier foundations in main pipe line shall be one-eighth (1/8) inch below base of main pipe line.

(f) In the case of pipe runs shall be side view for running and

(g) Pipe lines shall be laid out and dimensioned (4'-0") inch centers and shall be supported on pipe carriers placed not more than eight (8) feet apart on tangent and on curves of two (2) degrees or more they shall be spaced not more than seven (7) feet centers.

(h) With the level in the center position of street, the couplings in pipe line shall be located not less than twelve (12) inches from pipe carriers.

(i) Where so specified, the beam track supports shall be used where they have been tested and approved for use in connection with the pipe line and shall be installed in place by Purchaser.

(j) Pipe lines running under tracks shall be arranged to permit removal, packing and proper running of track except where otherwise provided.

(k) Changes in pipe lines shall be made with deflecting radii and or curves as follows:

210. *Pipe and pipe lines. (k)—Continued.*

Angle of Deflection. Degrees.		Bars.	Radius.
0	to 11	..... with tang ends	.....
11	to 33½	22½ deg. with eye ends	72 inch.
33½	to 56	45 deg. with eye ends	36 inch.
56	to 78½	67½ deg. with eye ends	24 inch.
78½	to 90	90 deg. with eye ends	18 inch.
Degrees.		Radial arms and cranks.	
0	to 30	15 deg. radial arm cranks.	
30	to 75	60 deg. acute angle cranks.	
75	to 105	90 deg. right angle cranks.	
105	to 140	120 deg. obtuse angle cranks.	
140	to 180	180 deg. equalizing arms.	1911.

(l) Deflecting bars shall not be used at any point where the total movement of the pipe line due to stroke expansion and contraction is more than eleven (11) inches.  
 1916.

(m) Offsets in pipe lines shall be made in body of jaws, or an iron rod one and eleven-thirty-seconds (1 11/32) inch in diameter. The total offset between any two supports shall not exceed three and one-half (3½) inches; minimum distance between ends of offset shall not be less than twice the amount of the offset. Offsets in cranks and compensators shall be avoided as far as practicable.  
 1914.

212. *Stuffing boxes.*

*Material.*

(a) Stuffing boxes for one (1) inch pipe shall be in accordance with R. S. A. drawing 1225.  
 1916.

*Field work.*

(b) Where necessary to run pipe lines underground, they shall be encased in two (2) inch galvanized iron pipe filled with non-freezing oil and provided at each end with a stuffing box.  
 1916.

213. *Pipe carriers.*

*Material.*

(a) Pipe carriers shall be in accordance with R. S. A. drawings 1071, 1072, 1073, 1084 and 1085.  
 1916.



# Pipe and pipe lines. (A)---Continued.

Radius.	Deflection.	Deflection.
18 inch.	75 deg. with eye ends	0 to 11
24 inch.	60 deg. with eye ends	11 to 35 1/2
30 inch.	45 deg. with eye ends	35 1/2 to 56
36 inch.	30 deg. with eye ends	56 to 75 1/2
42 inch.	15 deg. with eye ends	75 1/2 to 90
48 inch.	15 deg. radial arm cranks	0 to 30
54 inch.	60 deg. acute angle cranks	30 to 75
60 inch.	90 deg. right angle cranks	75 to 105
66 inch.	120 deg. obtuse angle cranks	105 to 140
72 inch.	180 deg. equalizing arms	140 to 180

(1) Deflecting bars shall not be used at any point where the total movement of the pipe line due to stroke expansion and contraction is more than (11) inches.

(2) Where necessary to run pipe lines underground, they shall be enclosed in two (2) inch galvanized iron pipe fitted with non-freezing oil and provided at each end with a stuffing box.

(3) Where necessary to run pipe lines underground, they shall be enclosed in two (2) inch galvanized iron pipe fitted with non-freezing oil and provided at each end with a stuffing box.

(4) Pipe carriers shall be in accordance with R. S. A. drawings 1071, 1072, 1073, 1074 and 1075.

(5) Where necessary to run pipe lines underground, they shall be enclosed in two (2) inch galvanized iron pipe fitted with non-freezing oil and provided at each end with a stuffing box.

(6) Pipe carriers shall be in accordance with R. S. A. drawings 1071, 1072, 1073, 1074 and 1075.

213. *Pipe carriers.—Continued.*

*Field work.*

(b) Pipes leading under track rails shall be supported by transverse pipe carriers. 1916.

(c) Pipe carriers for main pipe runs shall be fastened to iron foundations with two (2) one-half ( $\frac{1}{2}$ ) inch bolts and to wood foundations with two (2) one-half by two and one-half ( $\frac{1}{2} \times 2\frac{1}{2}$ ) inch lag screws. 1916.

(d) Transverse pipe carrier bearers shall be fastened to foundations with two (2) three-quarter by four ( $\frac{3}{4} \times 4$ ) inch lag screws. 1916.

(e) Strap pipe carriers shall be fastened to foundations with two (2) one-half by two and one-half ( $\frac{1}{2} \times 2\frac{1}{2}$ ) inch lag screws. 1911.

220. *Compensators.*

*Material.*

(a) Compensators shall be in accordance with R. S. A. drawings 1013, 1014 and 1231. 1916.

(b) Not more than one (1) horizontal, or more than two (2) vertical compensators shall be mounted on one (1) stand. 1911.

*Field work.*

(c) In territory where the temperature variation is less than one hundred and twenty (120) degrees, compensation shall be provided for each pipe line as follows:

1. Lengths forty (40) feet to seven hundred (700) feet, connected to switches, movable point frogs and point derails with ten by thirteen ( $10 \times 13$ ) inch arms. 1916.

2. Lengths eighty (80) feet to seven hundred (700) feet connected to facing point locks, switch and lock movements, lift derails, signals, etc., with ten by thirteen ( $10 \times 13$ ) inch arms. 1916.

3. Lengths seven hundred (700) feet to eleven hundred (1100) feet with ten by sixteen ( $10 \times 16$ ) inch arms. 1916.

4. Lengths over eleven hundred (1100) feet with additional compensators. 1916.

5. Not more than six hundred and twenty-five (625) feet of pipe shall be compensated by an eleven and three-fourths ( $11\frac{3}{4}$ ) inch crank. 1916.

(b) Pipes having more than one joint shall be secured by transverse pipe clamps.

(c) Pipe clamps for main pipe runs shall be fastened to iron foundations with two (2) one-half (1/2) inch bolts and to wood foundations with two (2) one-half (1/2) inch lag screws.

(d) Transverse pipe clamps shall be fastened to foundations with two (2) three-quarter (3/4) inch lag screws.

(e) Strap pipe clamps shall be fastened to foundations with two (2) one-half (1/2) inch bolts.

(a) Compensators shall be in accordance with E. & A. drawings for **VALVE**.

(b) Not more than one (1) horizontal or more than two (2) vertical compensators shall be mounted on one (1) main **SHOULD BE**.

(c) In territory where the temperature variation is less than one hundred and twenty (120) degrees, compensation shall be provided for one pipe line as follows:

1. Lengths forty (40) feet to seven hundred (700) feet, connected to swingable movable point locks and point details with ten (10) thirteen (13) inch cranks.

2. Lengths eighty (80) feet to seven hundred (700) feet connected to facing point locks, switch and lock movements, lift details, signals, etc., with ten (10) thirteen (13) inch cranks.

3. Lengths seven hundred (700) feet to eleven hundred (1100) feet, with ten (10) thirteen (13) inch cranks.

4. Lengths over eleven hundred (1100) feet with additional compensators.

5. Not more than six hundred and twenty (620) feet of pipe shall be compensated by an eleven and three-fourths (11 3/4) inch crank.

220. *Compensators.—Continued.*

(d) In territory where temperature variation is more than one hundred and twenty (120) degrees, compensation shall be provided for each pipe line as follows:

1. Lengths forty (40) feet to five hundred (500) feet connected to switches, movable point frogs, and point derails with ten by thirteen (10 x 13) inch arms. 1916.

2. Length seventy (70) feet to five hundred (500) feet connected to facing point locks, switch and lock movements, lift derails, signals, etc., with ten by thirteen (10 x 13) inch arms. 1916.

3. Lengths five hundred (500) feet to eight hundred (800) feet with ten by sixteen (10 x 16) inch arms. 1916.

4. Lengths over eight hundred (800) feet with additional compensators. 1916.

5. Not more than four hundred and thirty (430) feet of pipe shall be compensated by an eleven and three-quarters (11¾) inch crank. 1916.

6. One screw jaw shall be placed in the pipe line on the tower side of each compensator. 1916.

(e) Compensation shall be provided in pipe lines in accordance with R. S. A. drawing 1102. 1916.

230. *Jaws and lugs.*

*Material.*

(a) Jaws and lugs shall be in accordance with R. S. A. drawings 1016, 1017, 1018 and 1019. 1916.

*Field work.*

(b) Solid jaws shall be used for connections to all cranks, compensators, deflecting bars, couplers, rail locks, pipe connected levers and balance levers, unless otherwise specified. 1911.

(c) Screw jaws shall be placed in pipe line as follows: One (1) for each switch and lock movement, detector bar connection, bolt lock connection, each end of bolt lock bar, signal and .....; they shall be located as close as practicable to the unit to be adjusted. 1916.

235. *Pipe adjustments.*

*Material.*

(a) Pipe adjusting screws shall be in accordance with R. S. A. drawing 1002. 1916.

Temperature Variation

(b) In territory where temperature variation is more than one hundred and twenty (120) degrees, compensation shall be provided for each foot of pipe.

1. Lengths forty (40) feet to five hundred (500) feet connected to switches, movable point locks, and point details with ten by thirteen (10 x 13) inch

2. Lengths seventy (70) feet to five hundred (500) feet connected to locking point locks, switch and lock movement, lift details, signals, etc., with ten by thirteen (10 x 13) inch arms.

3. Lengths five hundred (500) feet to eight hundred (800) feet with ten by sixteen (10 x 16) inch arms.

4. Lengths over eight hundred (800) feet with 12

5. Not more than four hundred and thirty (430) feet of pipe shall be compensated by an eleven and

6. One screw jaw shall be placed in the pipe line on the tower side of the

(c) Compensation shall be provided in pipe lines in ac-

300. Jaws and jaws.

Material.

(a) Jaws and jaws shall be in accordance with R. S. A. drawings and 1007, 1018 and 1019.

(b) Screw jaws shall be used for connections to all pipe connected levers and balance levers, unless otherwise specified.

(c) Screw jaws shall be placed in pipe line as follows: One (1) for each switch and lock movement, detector bar connection, bolt lock connection, each end of bolt lock bar signal and ..... they shall be located as close as practicable to the unit to be adjusted.

Pipe adjustment.

Material.

(a) Pipe adjusting screws shall be in accordance with R. S. A. drawing 1002.



235. *Pipe adjustments.—Continued.*

*Field work.*

(b) Pipe adjusting screws shall be placed in each pipe line as follows:

1. One (1) for each facing point lock.
2. One (1) for each switch and lock movement.
3. One (1) for high signal.
4. One (1) for dwarf signal.
5. One (1) for bridge lock and couplers.
6. Two (2) for each through connection made by bridge couplers. 1914.

(c) Pipe adjusting screws shall be located as near as practicable to the unit to be adjusted without being directly under the track rails, guard rails, frogs, switches or bridge guards. 1914.

(d) Switches, derails, movable wing frogs and movable point frogs shall be provided with switch adjustments fastened to the head rods. 1911.

260. *Pins.*

*Material.*

Jaw, crank and compensator pins shall be in accordance with R. S. A. drawing 1010. 1916.

261. *Bolts, screws and washers.*

*Material.*

(a) Bolts, tap bolts, set screws, and machine screws shall have United States standard threads, nuts and heads. 1914.

(b) Nuts, bolt heads, tap bolt heads, etc., used in connection with the machine shall be hexagonal; all others shall be square. 1911.

(c) Lag screws shall be standard with gimlet points and square heads. 1911.

(d) Washers shall be standard flat cut. 1911.

*Field work.*

(e) Lag screws shall be inserted their entire length into holes previously filled with oil. These holes shall be bored small enough to provide full thread. 1911.

(f) Flat washers shall be used under bolt heads, nuts and heads of lag screws where they come in contact with wood. 1911.

10. Washers

Weld work.

- (b) Pipe adjusting screws shall be placed in each pipe line as follows:
1. One (1) for each facing point lock.
  2. One (1) for each switch and lock movement.
  3. One (1) for high signal.
  4. One (1) for dwarf signal.
  5. One (1) for bridge lock and computers.
  6. Two (2) for each through connection made by

- (c) Pipe adjusting screws shall be located as near as practicable to the nut to be adjusted without being directly under the track rails, guard rails, frogs, switch points, frog, movable wing frogs and movable point frogs shall be provided with switch adjustments fastened to the head rods.

11. Bolts

Pin.

shall be in accordance with the following table:

12. Bolts, screws and washers.

Material.

- (a) Bolts, tap bolts, set screws and machine screws shall have United States standard threads, nuts and heads.
- (b) Nut, bolt heads, tap bolt heads, etc., used in connection with the machine shall be hexagonal; all others shall be standard with gasket points.
- (c) Lag screws shall be standard flat end.
- (d) Washers shall be standard flat end.

- (e) Lag screws shall be inserted their entire length into holes previously drilled with oil. These holes shall be bored small enough to provide full thread.
- (f) Flat washers shall be used under bolt head, nuts and heads of lag screws where they come in contact with wood.

FOUNDATIONS

270. *Foundations.\**

*Material.*

- (a) Pipe carrier foundations shall consist of:
  - 1. Iron piers with ..... tops and bottoms.
  - 2. Concrete piers with ..... tops and bottoms.
  - 3. .... 1911.
- (b) Iron pipe carrier foundation piers shall be in accordance with R. S. A. drawing 1109. 1916.
- (c) Concrete pipe carrier foundation piers shall be in accordance with R. S. A. drawing 1080. 1916.

*Field work.*

- (d) Foundations shall be rigid, level, and in good alignment. 1916.
- (e) Foundations shall be set parallel to track, except as otherwise specified. 1911.
- (f) Concrete foundations shall be in accordance with R. S. A. drawings 1103, 1104, 1105, 1106, 1107, 1108 and 1259. 1916.
- (g) Concrete foundations shall stand until properly set before any apparatus is connected thereto or placed thereon. 1911.
- (h) One (1) concrete pier shall be used for each pipe carrier foundation up to twenty-five and three-fourths ( $25\frac{3}{4}$ ) inches long, and one additional pier for each additional thirty-four (34) inches or fraction thereof. 1911.
- (i) Two (2) piers shall be used for each iron pier pipe carrier foundation up to forty-five (45) inches long and one (1) additional pier shall be provided for each additional thirty-six (36) inches or fraction thereof and intermediate piers shall be inverted. 1911.

271. *Signal foundation bolts.*

- (a) Foundation bolts for ground masts shall be one (1) inch by thirty-six (36) inches. 1911.
- (b) Foundation bolts for bracket signal posts shall be one and one-half ( $1\frac{1}{2}$ ) inches by sixty (60) inches. 1911.

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\*The dimensions for concrete foundations indicated are for level and solid ground. The Purchaser and Contractor shall jointly decide when deviations from specified sizes are necessary. 1916.

(a) Pipe carrier foundations shall consist of:

280. *Concrete.*

Concrete shall conform to R. S. A. specification.

1916.

290. *Boxing.*

Where boxing is specified, it shall be made of two by eight (2x8) inch ..... lumber, dressed one (1) side. Where bottom in boxing is specified, it shall be made of one (1) inch ..... rough lumber; through highways the sides shall be made of three by six (3x6) inch and three by ten (3x10) inch ..... lumber and shall be fastened to the foundation tops. Four by twelve (4x12) inch ..... lumber shall be used for tops and it shall be cut diagonally and not nailed to sides.

1911.

SWITCH CONNECTIONS

300. *Switch mechanism.*

*Material.*

(a) Switch mechanisms shall perform their normal operations in the following sequence:

1. Unlock switch.
2. Throw switch.
3. Lock switch.
4. Indicate.

1911.

(b) Switch and lock movements shall be provided with staggered locking for normal and reverse position of points.

1911.

(c) Parts of mechanism shall be strong enough to permit of stopping the switch at any point of its movement by the introduction of an obstruction between the point and stock rail without injury to any part.

1911.

(d) Switch and lock movements shall be securely bolted to five-eighths by twelve inch by four feet ten inch ( $\frac{5}{8}$ "x12"x4'10") steel plate.

1914.

(e) Switch mechanism shall be protected by substantial iron covers fastened to ties or mechanism with wrought or malleable iron fastenings, in a manner to permit of convenient inspection of mechanism.

1911.

*Field work.*

(f) The location of switch operating mechanism shall be shown on ..... drawing ....., dated .....

1916.

(g) Mechanically operated lift derails may be direct connected without switch and lock movement or facing point lock if connected with switch circuit controller for indication on indicating lock lever.

1916.



Concrete shall conform to M. S. A. specification.

Reinforcing

Where boxing is specified, it shall be made of two by eight (2x8) inch ..... leather threaded one (1) side. Where bottom in boxing is specified, it shall be made of one (1) inch ..... in those of the (1) in and three by ten (3x10) inch ..... and shall be fastened to the foundation tops. Four (4) twelve (4x12) inch ..... shall be used for tops and it shall be cut diagonally and not nailed to sides.

SWITCH AND LOCK MECHANISM

Material

(a) Switch mechanism shall perform their normal operations in the following sequence:

(b) Switch and lock mechanism shall be provided with locking for normal and reverse position.

(c) Parts of mechanism shall be strong enough to stop the switch in any point of its movement by the introduction of an obstruction between the parts and stick rail without injury to any part.

(d) Switch and lock movements shall be accurately bolted to five (5) inch by twelve (12) inch by four (4) inch steel plate.

(e) Switch mechanism shall be protected by substantial iron covers fastened to ties or mechanism with wrought or malleable iron fastenings, in a manner to permit of convenient inspection of mechanism.

(f) The location of switch operating mechanism shall be shown on ..... drawing.

(g) Mechanically operated lift details may be directly connected without switch and lock movement on facing point lock if connected with switch circuit controller for indication on indicating lock lever.

300. *Switch mechanism.*—Continued.

(h) Parts of mechanism and covers shall be placed outside of clearance limits, as shown on ..... drawing ..... dated ..... 1916.

301. *Mechanical connections.*

(a) Arrangement and support of connections shall be such that switch points can be stopped by placing an obstruction between point and stock rail at any part of stroke, without breaking or bending any connections; also shall be strong enough to prevent bending or breaking in case mechanism is operated when detector bar is engaged by wheels of a car or engine. 1911.

(b) Both the operating and the lock rod shall be of sufficient strength to alone and independently hold the switch points in position. 1911.

310. *Facing point locks.*

*Material.*

(a) Facing point lock stands and plungers shall be in accordance with R. S. A. drawing 1096. 1916.

*Field work.*

(b) Switch and lock movements or facing point locks shall be used on all switches, derails, movable wing frogs and movable point frogs, except where otherwise specified on drawings. 1916.

(c) Where facing point locks are used they shall be arranged to lock switches in normal and reversed position and derails in ..... position. 1916.

(d) Facing point lock stands shall be placed outside of track as shown on drawing ....., dated .... 1916.

(e) Facing point lock plungers shall have full stroke of pipe line and stand one (1) inch clear of lock bar when switch is unlocked. 1911.

312. *Lock rods.*

*Material.*

(a) Lock rod shall be in accordance with R. S. A. drawing 1237. 1916.

*Field work.*

(b) Holes or notches in lock rods and ends of plungers or locking dogs, shall have square edges, and the holes or notches shall be not more than one-sixteenth ( $1/16$ ) inch

Switch Mechanism—Continued.

(h) Parts of mechanism...  
...as shown on...  
...dated...  
1916

(a) Arrangement and support of connections shall be such that points can be dropped by placing an ob-  
stacle, without breaking or...  
also shall be strong enough to...  
ing in case mechanism is operated when detector bar is  
engaged by wheels of a car or engine.  
1911.  
(b) Both the operating and the lock rod shall be of  
sufficient strength to alone...  
switch points in position.

(a) Facing point lock stands and plungers shall be in  
accordance with R. & A. drawing 1000.  
1916.

(c) Where facing point locks are used they shall be  
arranged so lock switches in normal and...  
position.  
1916.

(d) Facing point lock stands shall be placed outside of  
track as shown on drawing... dated...  
1916.

switch is unlocked.

Lock rods.

laterally.

(a) Lock rod shall be in accordance with R. & A. draw-  
ing 1037.  
1916.

field work.

(b) If... of notches in lock rods...  
or locking dogs shall have square... and the holes or  
notches shall be...  
1916.

312. *Lock rods.* (b)—Continued.

larger than the plunger or locking dog, measured in a horizontal line. 1916.

(c) Lock rods shall run direct from front rods or switch lugs into lock stands. 1914.

313. *Bolt locks.\**

*Material.*

(a) Bolt locks shall be in accordance with R. S. A. drawing 1095. 1916.

*Field work.*

(b) Lock rod shall be connected to point lug in accordance with R. S. A. drawing 1223—(detail 122318). 1916.

(c) When switches are located between interlocking station and signal, the signal bar of bolt lock shall form a part of the pipe line operating the signal; when switches are not located between interlocking station and signal, the signal bar of bolt lock shall form a part of the pipe line operating the signal. 1916.

(d) When electric locking or switch circuit controllers are not used, facing point switches, movable wing frogs and movable point frogs in high speed routes shall be bolt locked with signals governing such routes, and all facing derails shall be bolt locked with all signals governing over them. 1914.

320. *Gauge, butt and riser plates.*

*Material.*

(a) Gauge plates shall be  
    { one-half by six ( $\frac{1}{2} \times 6$ )  
    { three-fourths by six ( $\frac{3}{4} \times 6$ ) } inch merchant bar steel  
or of following composition:

---

\*Where local conditions are such that it is not practicable to install bolt locking, it is recommended that circuit controllers be placed on facing switches, derails, movable wing frogs and movable point frogs, and that their respective operating levers be provided with electric locks on lock levers to insure that switches have responded to the position of the lever, or where semi-automatic signals are used, they shall be controlled by circuit controllers on switches, derails, movable wing frogs and movable point frogs. 1916.

larger than the plunger or locking dog measured in a horizontal line.  
(c) Lock rods shall run direct from front rods or switch into lock stands.  
1914

Bolt locks\*

Material

(a) Bolt locks shall be in accordance with R. S. A. drawing 100.  
1916

Field work

(b) Lock rod shall be connected to pointing in accordance with R. S. A. drawing 100--(detail 10018). 1916

(c) When switches are located between interlocking station and signal, the signal bar of bolt lock shall form a part of the pipe line operating the signal; when switches are not located between interlocking station and signal, the signal bar of bolt lock shall form a part of the pipe line operating the signal.  
1916

12. When switches are located between interlocking station and signal, the signal bar of bolt lock shall form a part of the pipe line operating the signal; when switches are not located between interlocking station and signal, the signal bar of bolt lock shall form a part of the pipe line operating the signal.  
1914

13. Gauge, butt and tier plates.

Material

(a) Gauge plates shall be  
one-half by six (1/2x6)  
three-fourths by six (3/4x6)  
or of following composition:  
1914

\*Where local conditions are such that it is not practicable to install bolt locking, it is recommended that circuit controllers be placed on facing switches, details movable wing frogs and movable point frogs, and that their respective operating levers be provided with electric locks on lock levers to insure that switches have responded to the position of the lever, or where semi-automatic signals are used, they shall be controlled by frogs and movable point frogs.  
1916



320. *Gauge butt and riser plates. (a)—Continued.*

Carbon	.35 to .45	
Manganese	.40 to .60	
Sulphur (not to exceed)	.04	
Phosphorus (not to exceed)	.04	1916.

(b) Butt plates shall be merchant bar steel, one by three by six (1x3x6) inch; drilled for three (3) three-fourths (¾) inch rivets; middle rivet staggered. 1916.

(c) Riser plates shall be wrought iron three-eighths by six by ten (¾x6x10) inch, drilled for two (2) three-fourths (¾) inch rivets four (4) inches between centers and eight and one-half (8½) inches from the rail end of the plate and one (1) three-fourths (¾) inch rivet one and one-half (1½) inch from the rail end of the plate.

1911.

*Field work.*

(d) Not less than three (3) gauge plates shall be used for all switches and split point derails and shall be located so that one (1) plate shall be placed on point tie, and one (1) on nearest tie on each side and extended under plate supporting facing point lock and base plate for switch and lock movement.

1916.

(e) Not less than four (4) gauge plates shall be used for each set of movable point frogs and shall be located so that one (1) plate will be placed on point tie and one (1) on first tie back of point tie for each pair of points.

1916.

(f) Gauge plates shall be fitted in place and securely fastened to the ties with ..... (..) three-fourths by four (¾x4) inch lag screws or screw spikes. 1916.

322. *Rail braces.*

*Material.*

(a) Rail braces shall be { solid  
 adjustable } of the .....  
 ..... type. 1916.

*Field work.*

(b) Rail braces shall be used on gauge plate on point tie and on gauge plates each side of point tie for all switches and split point derails. For each set of movable point frogs, braces shall be used on gauge plate on point tie and on gauge plate on first tie back of point tie for each pair of points.

1916.



330. Tie straps.

*Material.*

- (a) Tie straps shall be one-half by two ( $\frac{1}{2} \times 2$ ) inch merchant bar steel. 1916.

*Field work.*

- (b) Tie straps shall be used at all switches, derails, movable wing frogs and movable point frogs, to tie all crank, rocking shaft, point and intermediate tie together, placed on top of ties and fastened to each tie with one (1) three-fourths by four ( $\frac{3}{4} \times 4$ ) inch lag screw or ..... track spikes. 1916.

DETECTOR BARS

340. Detector bars.

*Material.*

- (a) Detector bars and driving pieces shall be in accordance with R. S. A. drawing 1098. 1915.  
(b) Rail clips shall be in accordance with R. S. A. drawing 1099. 1915.

*Field work.*

- (c) Bars shall be located as shown on ..... drawing ..... unless otherwise specified. 1911.

(d) Detector bars shall be arranged to give ..... (...) feet continuous protection for all switches, derails, movable wing frogs, and movable point frogs. 1911.

(e) Detector bars, when practicable, shall be so connected that the unlocking movement when switch is in the main line position shall be in reverse direction to the facing movement of traffic over the points. 1915.

(f) Fifty-three (53) feet bars shall be mounted on sixteen (16) rail clips and a proportionate number of clips shall be used for longer or shorter bars. 1911.

(g) Center of rail clips shall be placed eight (8) inches and twenty-six (26) inches respectively from end and the remaining clips approximately three (3) feet nine (9) inches apart. 1911.

(h) Bars shall rise a minimum of three-fourths ( $\frac{3}{4}$ ) inch above top of rail at every point during the locking and unlocking of the switch, and shall rest one-fourth ( $\frac{1}{4}$ ) inch below top of rail at every point when lever travel is completed. 1911.

(i) Where radial arm clips are used combination bar stops and guides shall be provided, one (1) for every ten (10) feet of bar (equally spaced) and not less than two (2) such stops in one (1) bar. 1911.

(a) The straps shall be one-half by two (1/2" x 2") iron merchant bar steel.

Field work.

(b) The straps shall be used at all switches, details movable wire frame and shall be fastened to each tie with one (1) three-fourths by four (3/4" x 4") inch lag screw or track spikes.

DETECTOR BARS

Detector bars.

Material.

(a) Detector bars and driving pieces shall be in accordance with R. S. A. drawing 1000.

(b) Rail clips shall be in accordance with R. S. A. drawing 1001.

When the trucking movement when switch is in the main line position shall be in reverse direction to the trucking movement when switch is in the house position.

(1) Fifty-three (53) feet bars shall be mounted on sixteen (16) rail clips and a proportionate number of clips shall be used for longer or shorter bars.

(2) Center of rail clips shall be placed eight (8) inches and twenty-six (26) inches respectively from end and the remaining clips approximately three (3) feet nine (9) inches apart.

is completed.

(i) Where radial arm clips are used combination bar stops and guides shall be provided, one (1) for every ten (10) feet of bar (equally spaced) and not less than two (2) such stops in one (1) bar.

340. *Detector bars.*—Continued.

- (j) Driving pieces shall be placed midway between two  
(2) clips in space not occupied by joint in bar, and the  
driving rod shall have a length of not more than seven  
(7) feet unsupported. 1915.

348. *Section locking circuits.*

Section locking circuits  $\left\{ \begin{array}{l} \text{will} \\ \text{will not} \end{array} \right\}$  be required in  
 $\left\{ \begin{array}{l} \text{addition to} \\ \text{lieu of} \end{array} \right\}$  detector bars. 1914.

SIGNALS

400. *Type and assembly.*

- (a) Signals shall be of the semaphore type with an arm  
travel of ..... (..) degrees in the .....  
 $\left\{ \begin{array}{l} \text{right} \\ \text{left} \end{array} \right\}$  quadrant. 1916.
- (b) The type of signals (as shown by the R. S. A.  
symbols) and location of signals shall be in accordance  
with ..... drawing ..... 1916.

*Material.*

- (c) Signals and fittings shall be in accordance with the  
following R. S. A. drawings:

- 1026—Ladders.  
1027—Ladder parts.  
1029—Ladder clamps and stays.  
1032—Channel column bracket post.  
1033—Mounting for bottom mast mechanism case on  
bracket post.  
1034—Base for ground signal post.  
1035—Signal masts.  
1036—Base for bridge and bracket signal mast.  
1038—Base for pipe bracket post.  
1039—Pipe bracket post.  
1040—Semaphore spectacle, design "A."  
1041—Semaphore spectacle, design "B."  
1043—One-arm mechanical signal.  
1044—Two-arm mechanical signal.  
1045—Three-arm mechanical signal.  
1049—Lamp brackets.  
1050—Pinnacle.  
1052—Ladder foundation.  
1059—Clamp for base of ground signal masts.



(2) clips in space not occupied by joint in bar, and the driving rod shall have a length of not more than seven feet.

48. Section locking circuits.

Section locking circuits { will not { be required in {  
 { will {  
 { addition to {  
 { detector bars {  
 { of {  
 { total {

49. and assembly.

(a) Signals shall be of the semaphore type with an arm travel of ..... (b) Details in the .....  
 (c) The location of signals shall be in accordance with the following R. S. A. drawings:

- 1004--Base for ground signal post.
- 1005--Signal masts.
- 1006--Base for bridge and basket signal mast.
- 1007--Base for pipe basket post.
- 1008--Pipe basket post.
- 1009--Semaphore spectacle design "A".
- 1010--Semaphore spectacle design "B".
- 1011--One-arm mechanical signal.
- 1012--Two-arm mechanical signal.
- 1013--Three-arm mechanical signal.
- 1014--Lamp brackets.
- 1015--Pinnacle.
- 1016--Ladder foundation.
- 1017--Clamp for base of ground signal masts.
- 1018--Ladder parts.
- 1019--Ladder clamps and ...
- 1020--Channel column bracket.
- 1021--...

- \*1065—Blades for upper quadrant signals.
- 1070—Binding post.
- 1082—Mechanical semaphore bearing.
- 1083—U bolt and clamp.
- 1090—Filler block to limit travel of signal arms.
- 1091—Filler block to limit travel of signal arms.
- 1092—Filler block to prevent travel of signal arms.
- 1093—Diagram of spectacle clearances.
- 1097—Mechanical dwarf signal.
- 1178—Clamps for base of bridge and bracket masts.
- 1179—Details and assembly of hand rail for bracket mast.
- 1190—Mechanical connections for 6-way bracket post.
- 1191—Mechanical connections for 3-arm bridge and bracket mast.
- 1194—Details and assembly of mechanical semaphore bearing.
- 1196—Guides for vertical connections on bracket posts.
- 1198—Adjustable arm cranks and supports.
- 1199—Adjusting crank.
- 1232—Mechanical dwarf signal top and base bearings.
- \*1233—Mechanical dwarf signal spectacles and lamp bracket support.
- 1235—Semaphore spectacle, design "C."
- 1239—Mechanical dwarf signal fittings.

(e) Power operated dwarf signals shall be mechanically locked in the horizontal position of the arm except as otherwise specified.

\*\*Three-position  $\left\{ \begin{array}{l} \text{upper} \\ \text{lower} \end{array} \right\}$  quadrant dwarf spectacle shall be in accordance with ..... drawing  
..... 1916.

400. Type and assembly. (c)—Continued.

\*1062—Blades for upper quadrant signals.

Position post

1083—U bolt and clamp.

1090—Filler block to limit travel of signal arms.

1091—Filler block to limit travel of signal arms.

1092—Filler block to prevent travel of signal arms.

1093—Diagram of spectacle clearances.

1097—Mechanical dwarf signal.

1178—Clamps for base of bridge and bracket mount.

1179—Details and assembly of hand rail for bracket

mount.

1190—Mechanical connections for 6-way bracket

post.

1191—Mechanical connections for 3-arm bridge and

bracket mount.

1194—Details and assembly of mechanical semaphore

bracket.

1196—Guides for vertical connections on bracket

posts.

1198—Adjustable arm cranks and supports.

1199—

1232—Mechanical dwarf signal top and base housing.

\*\*1233—Mechanical dwarf signal spectacles and lamp

bracket support.

YR 1000-101

1234—Mechanical dwarf signal spectacles and lamp

bracket support.

capacities and mechanism constructed to per-

operation of a battery (90) degree, three (3) position sig-

nal of R. S. A. standard, in not more than

(...) seconds with battery at ten (10) per cent below

normal voltage.

(e) Power operated dwarf signals shall be mechanically

locked in the horizontal position of the arm except as

otherwise specified.

\*Blades (wood) for lower quadrant signals shall be in

conformance with

enamelled steel.

High blades shall be made of

well seasoned

enamelled steel blades shall be in accordance with

\*\*Three-position { upper

{ lower

quadrant dwarf spectacle

drawing

1016.

400. *Type and assembly.*—Continued.

(f) Motor dwarf signals shall be of  $\left\{ \begin{array}{l} \text{cast} \\ \text{wrought} \end{array} \right\}$  iron  
and shall be not more than ..... (..) feet .....  
..... (..) inches from base to center of bearing.  
1915.

(g) Base castings for dwarf signals shall be cored for  
..... (..) bolts ..... (..) inches in di-  
ameter at a radius of ..... (..) inch. 1915.

(h) Back lights  $\left\{ \begin{array}{l} \text{shall} \\ \text{shall not} \end{array} \right\}$  be furnished. When fur-  
nished, they shall be designed for one (1) .....  
glass. 1915.

(i) Dwarf signal blades shall be flexible or .....  
with dimensions in accordance with ..... drawing  
..... 1915.

(j) High signal semaphore shafts shall be made of  
steel not less than one and one-fourth ( $1\frac{1}{4}$ ) inches in di-  
ameter. 1915.

(k) Semaphore castings shall be mounted on square  
section of shaft. Operating arm shall be mounted on  
square section of shaft or otherwise securely fastened.  
1915.

(l) Dwarf signal semaphore shafts shall be made of  
cold rolled steel ..... (..) inches square. 1915.

*Field work.*

(m) Signal masts shall be on the right of the track  
governed and adjacent thereto, where practicable.  
1915.

(n) Signal arms on tangent shall be at right angles to  
track governed when sufficient approach is on tangent. On  
curves signal arms shall be at right angles to imaginary  
line drawn from signal to the point where the best view  
can be obtained by the engineman, as decided by the Pur-  
chaser. 1915.

(o) Before any signals are erected, the Purchaser shall,  
in the presence of the Contractor's foreman (or other  
representative), locate each signal. 1915.

(p) Outside of tracks, dwarf signals shall be placed  
..... (..) feet, ground masts ..... (..) feet and bracket posts ..... (..) feet from nearest  
rail. 1915.

(q) Bridge masts shall be located on .....  
chord or bridge. 1915.

(r) Base of dwarf signals shall be ..... (..) inches below base of rail. Base of high signals shall be level with base of rail unless otherwise specified. 1916.

Type and assembly.—Continued

- (1) Motor dwarf signals shall be of cast iron { cast }  
 { wrought }  
 (2) Base castings for dwarf signals shall be cast for 1915.  
 (3) Bolts ( ) inches in di-  
 (4) shall { be furnished. When fur- }  
 { shaft not }  
 nished, they shall be designed for one (1) 1915.  
 (5) Dwarf signal blades shall be flexible or 1915.  
 with dimensions accordance with drawing  
 (6) High signal semaphore blades shall be made of 1915.  
 steel not less than one and one-fourth (1 1/4) inches in di-  
 (7) Semaphore castings shall be mounted on separate 1915.  
 section of shaft. Connecting arm shall be mounted on 1915.  
 separate section of shaft or otherwise suitably fastened.  
 (8) Dwarf signal semaphore shafts shall be made of 1915.  
 (9) Signal mass shall be on the right of the track 1915.  
 (10) Signal mass shall be on the right of the track 1915.  
 (11) Signal mass shall be on the right of the track 1915.  
 (12) Signal mass shall be on the right of the track 1915.  
 (13) Signal mass shall be on the right of the track 1915.  
 (14) Signal mass shall be on the right of the track 1915.  
 (15) Signal mass shall be on the right of the track 1915.  
 (16) Signal mass shall be on the right of the track 1915.  
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 (99) Signal mass shall be on the right of the track 1915.  
 (100) Signal mass shall be on the right of the track 1915.



425. *Roundels.*

Roundels shall be in accordance with R. S. A. specification and shall be furnished as follows:

	Color.	Diameter. Inches.
Stop .....	.....	(..)
Caution .....	.....	(..)
Proceed .....	.....	(..)
Back light .....	.....	(..)

1916.

430. *Lamps.*

- (a) Lamps shall be { oil.  
 electric.  
 convertible. } 1914.
- (b) Oil lamps shall be in accordance with R. S. A. drawings 1100 and 1101. 1915.
- (c) Convertible lamps shall be equipped with .....  
 ..... (..) incandescent lamps in accordance with  
 ..... drawing ..... and with long time  
 oil founts and burners. 1915.
- (d) ..... (..) extra incandescent lamps shall  
 be furnished. 1911.
- (e) Incandescent lamps shall conform to .....  
 specification. 1915.

CIRCUITS

500. *Practice.*

Circuits shall conform to drawing ....., dated  
 ....., unless otherwise specified. 1916.

501. *Switchboard circuits.*

Switchboard circuits shall conform to .....  
 drawing ....., dated ..... unless other-  
 wise specified. 1916.

502. *Track circuits.*

- (a) The Contractor shall furnish ..... track  
 circuits as shown on Purchaser's drawing .....  
 dated ..... 1915.
- (b) Track circuits shall be continuous on all main  
 tracks and extend the full length of crossovers and to the  
 fouling point of turn-outs. Dead sections greater than  
 ..... (..) feet in length will not be permitted.  
 1915.

503. *Switch indicating circuits.*

Switch indicating circuits shall conform to drawing  
 ....., dated ....., unless otherwise speci-  
 fied. 1916.

Switch indicating circuits shall conform to drawing \_\_\_\_\_ dated \_\_\_\_\_ unless otherwise specified.

Switch indicating circuits

(b) Track circuits shall be continuous on all main tracks and extend the full length of crossovers and to the landing point of run-arounds. Dead sections greater than \_\_\_\_\_ feet in length will not be permitted.

(a) The Contractor shall furnish \_\_\_\_\_ track circuits as shown on Purchaser's drawing \_\_\_\_\_ dated \_\_\_\_\_.

102. Track circuits

Switchboard circuits shall conform to drawing \_\_\_\_\_ dated \_\_\_\_\_ unless otherwise specified.

Switchboard circuits shall conform to drawing \_\_\_\_\_ dated \_\_\_\_\_ unless otherwise specified.

Circuits shall conform to drawing \_\_\_\_\_ dated \_\_\_\_\_ unless otherwise specified.

CIRCUITS

(e) Incandescent lamps shall conform to \_\_\_\_\_

(d) \_\_\_\_\_ (e) extra incandescent lamps shall be furnished.

(c) Convertible lamps shall be equipped with \_\_\_\_\_ drawing \_\_\_\_\_ and with long time \_\_\_\_\_ oil lamps and burners.

(b) Oil lamps shall be in accordance with R. S. A. drawings \_\_\_\_\_ and \_\_\_\_\_.

(a) Lamps shall be \_\_\_\_\_ electric \_\_\_\_\_

430. Lamps

Back light \_\_\_\_\_

Freeseed \_\_\_\_\_

Cannon \_\_\_\_\_

Color \_\_\_\_\_

Inches \_\_\_\_\_

Roundels shall be in accordance with R. S. A. specifications and shall be furnished as follows:

504. *Home signal control.*

(a) High and restricted speed power operated signals shall be so controlled that unless all facing derails, switch and movable frog points over which they govern are in proper position, the signals will assume the stop position. Low speed power operated signals shall be controlled by derails in the same manner. 1916.

(b) Each distant or approach signal shall be controlled by circuit controllers on all signals, the indications of which it repeats, and so arranged that the circuit is broken unless all signals for the track governed are in proceed position. 1916.

(c) Signal circuits shall conform to drawing .....  
....., dated ....., unless otherwise specified. 1916.

505. *Cross protection circuits.*

.....  
.....  
..... 1911.

506. *Electric lighting circuits.*

(a) Circuits for electric lights shall be in accordance with plan submitted or approved by Purchaser. 1915.

(b) The maximum allowable drop in potential on electric lighting circuits from switchboard to any lamp shall be ten (10) per cent. 1911.

510. *Special circuits.*

(The Purchaser will here indicate in full detail all special circuit requirements.)

.....  
.....  
..... 1911.

WIRES AND WIRING

520. *Specifications.*

Wire and cable shall be in accordance with R. S. A. specifications. 1916.

521. *Size.*

(a) Wires shall be of sufficient size to permit operation of switch and signal mechanism in accordance with previous specifications. 1911.

Home signal control.

(a) High and restricted speed power operated signals shall be so controlled that unless all facing details switch and movable points over which they govern are in proper position the signals will assume the stop position. Low speed power operated signals shall be controlled by details in the same manner.

(b) Each distant or approach signal shall be controlled by circuit controllers on all signals, the indications of which it repeats, and so arranged that the unit is broken unless all signals for the track governed are in proceed position.

(c) Signal circuits shall conform to drawing . . . . .

1916

1916

(d) Circuit for signals shall be approved by Purchaser. The plan submitted on approval by Purchaser shall be ten (10) per cent.

210. Special circuit requirements. (The Purchaser will here indicate in full detail all special circuit requirements)

1917

WIRING AND WIRING

220. Specifications. Wire and cable shall be in accordance with R. S. A. specifications.

221. Size. (a) Wires shall be of sufficient size to permit operation of switch and signal mechanism in accordance with specifications.

521. *Size.—Continued.*

(b) Single conductor wires external to the interlocking station shall not be smaller than number fourteen (14) American Wire Gauge. Single conductor wires within the interlocking station shall not be smaller than number sixteen (16) American Wire Gauge. 1915.

(c) Wires in cable external to the interlocking station shall not be smaller than number sixteen (16) American Wire Gauge. 1915.

(d) Hard drawn copper or copper clad line wire shall not be smaller than number twelve (12) American Wire Gauge. 1915.

(e) No common return wire shall be less than number twelve (12) American Wire Gauge. 1915.

(f) In cable work, spare wires shall be provided as specified. When spare wires are required in other than cable work, the number and size shall be specified. 1915.

(g) Numbers and sizes of track circuit connections to each rail shall be as follows:

	No. of Conductors	American Wire Gauge
1. Track transformers or batteries to rail....	one (1)	..... (.)
2. Relay to each rail....	one (1)	..... (.)
3. Fouling shunt connections .....	two (2)	..... (.)
4. Switch circuit controller shunt connections	two (2)	..... (.)
5. Wire from trunking to track batteries in chutes, stranded ... ..	... (.)	..... (.)

1916.

(h) Wires connected to track shall be rubber-covered, soft-drawn copper. 1915.

525. *Wiring.*

(a) Wires in trunking, chases or conduits shall be laid loosely without stretching or crowding. 1911.

(b) Not more than two (2) wires shall be connected to one (1) binding post or terminal screw. 1911.

526. *Common return.*

(a) Unless otherwise specified, common return wires shall be continuous without joints between home and dwarf signal limits. 1915.



Continued.

(1) Single conductor wires shall be insulated with American Wire Gauge. Single conductor wires within the same race shall be insulated with American Wire Gauge.

(c) Wires in cable external to the interlocking station shall not be smaller than number sixteen (16) American Wire Gauge.

(d) Lead drawn copper or copper clad line wire shall not be smaller than number twelve (12) American Wire Gauge.

(e) No common return wire shall be less than number twelve (12) American Wire Gauge.

(f) In all cases where wires are grouped in a race, they shall be insulated with American Wire Gauge.

(g) Numbers and sizes of track circuit connections to each rail shall be as follows:

No. of American Wire Conductors	
1	Track transformers or batteries to rail...
2	Relay to each rail...
3	Holding shunt connections...
4	...
5	...
6	...
7	...
8	...
9	...
10	...
11	...
12	...
13	...
14	...
15	...
16	...
17	...
18	...
19	...
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36	...
37	...
38	...
39	...
40	...
41	...
42	...
43	...
44	...
45	...
46	...
47	...
48	...
49	...
50	...

(h) Wires connected to track shall be numbered consecutively.

(i) Wires connected to track shall be numbered consecutively.

(j) Not more than two (2) wires shall be connected to a single track.

(k) Unless otherwise specified, common return wires shall be continuous without joints between home and distant signal points.

526. *Common return.*—Continued.

(b) Connections between branches and main common wires shall be made in junction boxes. 1911.

(c) Reductions in size of common wire and connections to pole lines shall be made in junction boxes. 1911.

527. *Joints in wire.*

(a) Wires shall, as far as practicable, be continuous without joints between interlocking machine and the unit operated; joints when made shall be in junction boxes, and only made with permission from the Purchaser's representative. 1915.

(b) In making joints, braid shall be removed for a distance of one (1) inch from end of rubber on each side of joint, and rubber cut with knife held at an angle of approximately thirty (30) degrees with axis of wire, as one would sharpen a pencil, care being taken to prevent injury from small cuts or nicks. 1915.

(c) Wire, after being cleaned, shall be twisted together in the form of a regular line wire ("Western Union joint,") turns being spaced approximately one-sixty-fourth ( $1/64$ ) inch, or ..... 1915.

(d) The branch wire, after being cleaned, shall be wrapped around main wire, turns being spaced approximately one-sixty-fourth ( $1/64$ ) inch. 1915.

(e) Joints shall then be soldered by pouring on them, or dipping them into melted solder, a non-corrosive flux being used. After soldering, joints shall be covered with two (2) layers of rubber insulating tape between ends of braid, which tape shall be heated sufficiently to form a tight covering, but not enough to injure the quality of the material; insulating tape shall be in accordance with R. S. A. specification. Two (2) layers of friction tape shall be applied over the rubber insulation and the ends of the braiding, and this tape shall then be thoroughly coated with black asphaltum paint. The friction tape shall be in accordance with R. S. A. specification. 1916.

528. *Fuses.*

*Material.*

(a) Fuses shall be of the enclosed type, in accordance with R. S. A. drawing 1309. Fuse clips shall be mounted on an insulating base of fireproof material. 1915.

226. Common return.—Continued.

- (1) Connections between branches and main common wires shall be made in junction boxes.  
1917.  
(c) Reductions in size of common wire and connections to pole lines shall be made in junction boxes.  
1917.

227. Joints in wire.

Without joints between insulating material and the unit operated; joints when made shall be in junction boxes and only made with permission from the Purchaser's representative.

(b) In making joints, which shall be removed for a distance of one (1) inch from end of rubber on each side of joint, and rubber cap shall be held at an angle of approximately thirty (30) degrees with wire, as one would sharpen a pencil, care being taken to prevent in-

(c) Wire, after being cleaned, shall be twisted together in the form of a rope, the wire (Wireman's)

thirty-fourth (1/32) inch or

(d) The branch wire, after being cleaned, shall be wrapped around main wire, the wrapping spaced approximately every six (6) inches.

Joints shall then be soldered by dipping in molten solder, a non-corrosive flux being used. After soldered joints shall be covered with two (2) layers of rubber insulating tape between ends of joint, which tape shall be heated sufficiently to form a skin, covering but not enough to injure the quality of the material; insulating tape shall be in accordance with R. S. A. specification. Two (2) layers of friction tape shall be applied over the rubber insulation and the ends of the wiring, and this tape shall then be thoroughly coated with black non-staining paint. The friction tape shall be in accordance with R. S. A. specification. 1917.

228.

(a) Poles shall be of the enclosed size in accordance with R. S. A. specification 1909. Poles shall stand in accordance with an insulating base of R. S. A. specification. 1917.

528. *Fuses.*—Continued.

*Field work.*

(b) The necessary fuses to properly protect all apparatus and circuits, as required by the Purchaser, shall be installed. 1915.

(c) Fuses outside of buildings shall be enclosed in weatherproof boxes. 1911.

530. *Tags.*

Wires shall be identified at all terminals, by means of a non-metallic tag or label, on which is stamped the wire designation corresponding to that shown on the circuit and wiring plan. Where practicable, the tags shall be securely fastened adjacent to the terminal, so that the number can be easily read. 1915.

532. *Petroleum asphaltum.*

*Material.*

(a) Petroleum asphaltum shall be in accordance with R. S. A. specification. 1916.

*Field work.*

(b) When specified, the wires in trunking shall be loosely bound and shall be so laid in pitch as to be practically free of contact with all walls of the trunking. 1911.

(c) When petroleum asphaltum is used, terminal box bootlegs, trunking and bootleg terminals shall be in accordance with R. S. A. drawings 1154, 1155, 1156 and 1157. 1915.

BONDING

540. *Bonding wires.*

*Material.*

(a) Bonding wires shall be in accordance with R. S. A. specification. 1916.

*Field work.*

(b) Bonding shall be in accordance with ..... drawing ..... Rail joints shall be bonded with

two { copper clad }  
{ E. B. B. } bonding wires except when located  
{ copper }

in station platforms, road crossings or tunnels, in which cases, each joint shall be bonded either with four (4) E. B. B. wires, two being placed on either side of the rail, outside of the angle bar, or with two (2) number six

Field work.

- (b) The necessary fuse is properly placed in the  
 terminals and circuit, as required by the manufacturer,  
 be installed.  
 (c) Fuses outside of buildings shall be enclosed in  
 weatherproof boxes.

Wires shall be identified at all terminals by means of a  
 non-metallic tag or label, the which is stamped the wire  
 designation corresponding to that shown on the circuit  
 and wiring plan. Where practicable the tags shall be  
 securely fastened adjacent to the terminal, so that the  
 number can be easily read.

- (a) Potentiometer apparatus shall be in accordance with  
 R. S. A. specification.

Field work.

- (b) When specified, the wires in terminal shall be  
 loosely bound and shall be so labeled as to be placed  
 easily free of contact with all parts of the machine.  
 (c) When potentiometer apparatus is used, the  
 potentiometer shall be in accordance with R. S. A. drawing 1014-1-22, 1152 and  
 1153.

Resistance

Material.

- (a) Bonding wires shall be in accordance with R. S. A.  
 specification.

Field work.

- (b) Bonding shall be in accordance with  
 drawing 1014-1-22, 1152 and 1153.  
 Bonding wires except when located  
 in station plant, shall be bonded either with four (4)  
 cases, with joint shall be bonded either with four (4)  
 R. S. B. wires, two being placed on either side of the  
 rail, outside of the angle bar, or with two (2) number six



540. *Bonding wires.* (b)—Continued.

(6) American Wire Gauge, bare copper or copper-clad steel bonding wires. 1916.

(c) Frogs shall be bonded in the same manner as the rail joints and shall be so connected, that the continuity of the track circuit will be broken when they are removed from the track.

542. *Channel pins.*

### Material.

(a) Channel pins shall be in accordance with R. S. A. specification. Single channel pins shall be in accordance with R. S. A. drawing 1086. 1916.

### Field work.

(b) Each bond wire shall be fastened at each end into the web of the rail by a channel pin. 1911.

(c) Bonding shall be completed the same day that holes are drilled.

## ISOLATED BATTERY

550. *Type of battery.*

### Material.

Batteries shall be of the { primary  
storage } type and shall conform to R. S. A. specifications for

Caustic Soda Primary Battery.  
Pure Lead Type Stationary Storage Battery.  
Lead Type Portable Storage Battery.  
Nickel, Iron, Alkaline Storage Battery.

1915.

551. *Track batteries.*

### Field work.

(a) When primary battery is used, each track circuit shall be operated by at least two (2) cells connected in multiple. 1915.

(b) Storage batteries shall be of ..... (.)  
ampere-hour capacity. 1915.

552. *Signal and line control isolated batteries.*

(a) Storage batteries shall be of ..... (.)  
ampere-hour capacity, and conform to R. S. A. specifica-  
tion. 1916.

(b) Primary battery shall be of the { gravity  
type of ..... (..) capacity. { caustic soda }  
1915.

(c) Jars for caustic soda type of battery shall be

{ barrel shape	{ of {	heat resisting glass. }	{ 1915.
{ straight sided	{	porcelain. }	

(d) After the wire shall be in the same position as the steel binding wires.  
(c) The wire shall be bound in the same manner as the steel binding wires, and shall be so connected, that the continuity of the wire shall be maintained when they are removed from the track.

542. Channel pins shall be in accordance with R. S. A. specification. Steel channel pins shall be in accordance with R. S. A. drawing 1080.

(b) Each bond wire shall be fastened at each end into the web of the rail by a channel pin.  
(c) Bonding shall be completed the same day that the work is completed.

ISOLATED BATTERY

Batteries shall be of the type specified in the R. S. A. specification for Isolated Battery.

551. Track Batteries

(a) When necessary, battery is used, each track circuit shall be operated by at least two (2) cells connected in series.  
(b) Storage batteries shall be of the type specified in the R. S. A. specification for Track Batteries.

552. Storage and time control isolated batteries shall be of the type specified in the R. S. A. specification for Storage Batteries, and conform to R. S. A. specification.

(f) Primary battery shall be of the type specified in the R. S. A. specification for Primary Batteries, and conform to R. S. A. specification for Primary Batteries.

CONTROL APPARATUS

600. *Relays.*

Relays shall conform to R. S. A. specification for  
Neutral Type D.C. Relays. 1916.

610. *Circuit controllers.*

*Material.*

(a) Circuit controllers of substantial construction and positive in action shall be connected to switches as specified and shall be so constructed that they can be maintained to make or break circuit when switch point shall be moved from the closed position three-sixteenths ( $\frac{3}{16}$ ) or ..... (..) of an inch. 1915.

(b) Operating rods of switch circuit controller shall be not less than three-fourths ( $\frac{3}{4}$ ) inch in diameter and adjustable, with a maximum distance of three (3) feet between supports. 1915.

(c) Circuit controllers for non-interlocked switches shall have two independent shunt connections from the circuit controllers to the track circuits of each track affected by the opening of switch and shall shunt tracks when switch point shall have been opened from the closed position three-sixteenths ( $\frac{3}{16}$ ) or ..... (..) of an inch. 1915.

*Field work.*

(d) The switch circuit controller shall be positively connected to one or both points; if but one, the normally ..... shall be selected. 1911.

(e) The switch circuit controller shall be insulated from the gauge plate and from the track. 1916.

(f) Where facing point locks are used, circuit controllers shall be placed on switches, derails, movable wing frogs and movable point frogs, and their respective operating levers be provided with electric locks on lock levers to insure that switches have responded to the position of the lever. 1916.

615. *Electric locks.*

Electric locks shall be installed as required by the Purchaser and shall conform to ..... specification. 1915.

618. *Releases.*

Releases shall be installed as required by the Purchaser and shall conform to R. S. A. specification. 1916.

Relays.

Relays shall conform to R. S. A. specification for Neutral Type D.C. Relays.

### Wiring

(a) Circuit controllers or substantial construction and wiring in action shall be connected to switches as specified and shall be so constructed that they can be maintained in the closed position when switches are closed. They shall be moved from the closed position three times in (4) of the test.

(b) Operating rods or similar circuit construction shall be not less than 1/8 inch (1.6 mm) in diameter and adjustable with a maximum distance of three (3) feet.

(c) Circuit controllers for non-interlocked switches shall have two independent shunt connections from the circuit controllers to the switch contacts of each switch. The opening of switches and shunt connections shall be opened from the closed position three times in (4) of the test.

connected to one or both points; if not, they shall be connected to one or both points.

the gauge plate and from the track.

(f) Where facing point locks are used, circuit controllers shall be placed on switches directly opposite the facing point locks and from respective ends. The facing point locks shall be provided with electric locks on both ends to insure that switches have responded to the position of the facing point locks.

Electric locks shall be installed as required by the facing point locks and shall conform to R. S. A. specification.

Switches shall be installed as required by the facing point locks and shall conform to R. S. A. specification.

619. *Time releases.*

Time releases shall be installed as required by the Purchaser, and shall conform to ..... specification. 1915.

625. *Indicators.*

Indicators shall be installed as required by the Purchaser, and shall conform to ..... specification. 1915.

630. *Annunciators.*

Annunciators shall be installed as required by the Purchaser, and shall conform to ..... specification. 1915.

635. *Lightning arresters.*

*Material.*

(a) Lightning arresters of ..... design shall be used at all aerial line connections. 1911.

*Field work.*

(b) A ground connection shall be provided at each lightning arrester location. Ground connection shall be in accordance with drawing or specification submitted or approved by the Purchaser. 1915.

TRUNKING, CONDUITS AND SUPPORTS

700. *Trunking.*

*Material.*

(a) Grooved trunking, built up trunking and all capping shall be ..... lumber and conform to R. S. A. specification. 1916.

(b) The dimensions for trunking shall be in accordance with R. S. A. drawings 1176 or 1177. 1916.

(c) Treated trunking shall be used when specified, and shall conform to the attached requirements as to treatment. 1916.

(d) The location of the main runs of trunking is shown on ..... drawing ..... 1911.

(e) Permission shall be obtained to place between tracks, runs of trunking parallel with the tracks. 1911.

(f) Trunking when on stakes above ground and running parallel with the track, shall not be placed nearer than six (6) feet from the gauge side of the nearest rail except by special permission. 1911.

(g) Local conditions shall determine the height of trunking when above ground; in general, when trunking is run parallel with the tracks, bottom of trunking shall be placed approximately six (6) inches above ground. 1911.



619. Time releases shall be installed as required by the  
Purchaser, and shall conform to the specification  
1915.

620. Indicators shall be installed as required by the  
Purchaser, and shall conform to the specification  
1915.

621. Annunciators shall be installed as required by the  
Purchaser, and shall conform to the specification  
1915.

622. Material  
(a) Lightning arresters of the design shall be  
used at all aerial line connections  
1915.

623. (b) A ground connection shall be provided at each  
lighting arrester location. Ground connection shall be  
in accordance with drawing or specification submitted or  
approved by the Purchaser  
1915.

624. TRUNKING, CONDUITS, AND CABLES

(a) Grooves, channels, race up runways, and other  
shall be of the material and conform to R. S. A.  
specification  
1915.

(b) The dimensions for trunking shall be in accordance  
with R. S. A. drawings 1176 or 1177.  
1915.

(c) Trunking shall be used when specified, and  
shall conform to the attached requirements as to test-  
ment.  
1915.

(d) The location of the main runs of trunking is shown  
on the drawing.  
1915.

(e) Permission shall be obtained to place between  
trunking runs of trunking parallel with the tracks.  
1915.

(f) Trunking when on stakes above ground and run-  
ning parallel with the track shall not be placed nearer  
than 18 inches to the edge of the track.  
1915.

(g) Local conditions shall determine the height  
when above ground; in general, when trunking is  
1915.

(h) Trunking shall be placed approximately six (6) inches above ground.  
1915.

700. *Trunking.*—Continued.

- (h) Trunking shall be so installed that there will be sufficient slope for drainage. 1915.
- (i) Nails shall not be driven through the trunking from the inside of the groove nor shall they be driven into the groove from the outside. 1911.
- (j) Inside corner of trunking, at turns, must be rounded to prevent insulation on wires being injured. 1911.
- (k) Surfaces of trunking that are to be painted shall be finished. 1911.
- (l) Not less than  $\left\{ \begin{array}{l} \text{twenty-five (25)} \\ \text{..... (..)} \end{array} \right\}$  per cent. of the capacity of the groove shall remain free for the further installation of wires. 1915.
- (m) Capping shall be securely fastened to the trunking in a manner satisfactory to the Purchaser. 1915.

703. *Joints in trunking.*

- (a) Joints in grooved trunking shall be  $\left\{ \begin{array}{l} \text{lapped} \\ \text{mitered} \end{array} \right\}$  and shall be made in a manner satisfactory to the Purchaser. 1915.
- (b) Joints in built up trunking shall be staggered. 1911.
- (c) Joints in capping shall be made at least one (1) foot from joints in trunking. 1911.

705. *Trunking supports.*

*Material.*

- (a) Stakes shall be made of ..... three by four (3x4) inches, or of equivalent circular section and of sufficient length to allow them to be placed at least two (2) feet in the ground. When, due to local requirements, stakes of a greater length than three (3) feet six (6) inches, or a greater cross section than three by four (3x4) inches will be necessary, information as to the number, length and cross section will be furnished by the Purchaser. 1915.

*Field work.*

- (b) Trunking above ground shall be supported on stakes placed not more than five (5) feet centers. 1911.
- (c) When trunking exceeds a width of seven (7) inches a special arrangement consisting of  $\left\{ \begin{array}{l} \text{a double line of stakes} \\ \text{a single line of large stakes} \end{array} \right\}$  shall be installed, or provision shall be as follows:.....



705. *Trunking supports.*—Continued.

(d) Stakes supporting trunking shall be placed vertically and extend at least two (2) feet below the surface of the ground, unless otherwise specified. 1911.

(e) A piece of capping eight (8) inches long and the width of the trunking shall be placed between the trunking and each stake. 1911.

(f) Each joint in the bottom of the trunking shall be supported by a stake. 1911.

708. *Bootlegs.*

Bootlegs for track connection shall be made in accordance with ..... drawing ..... They shall be securely fastened to the trunking, not less than two (2) inches from base of rail, and shall not extend more than one (1) inch above base of rail. 1911.

710. *Junction boxes.*

*Material.*

(a) Junction boxes shall be made of ..... and so designed that terminals will be kept dry. Each junction box shall be fitted with a cover, hasp and staple. 1911.

(b) Where ten (10) or less wires are used, junction boxes shall be sixteen (16) inches square by twenty (20) inches deep, inside dimensions, and shall be increased six (6) inches in length for each ten (10) additional connections or fraction thereof made in the box. 1911.

(c) Junction terminals shall be in accordance with R. S. A. drawing 1056. 1916.

*Field work.*

(d) Junction boxes shall be located as shown on ..... drawing ..... and at a height sufficient to allow terminals to be placed at least six (6) inches above top of trunking. 1911.

(e) Junction boxes shall be supported in the same manner as the trunking. 1911.

711. *Conduits.*

(a) Fibre conduits shall be in accordance with R. S. A. specification. 1916.

(b) Vitrified clay conduits shall be in accordance with R. S. A. specification. 1916.

714. *Line construction.*

Line construction shall conform to local laws. 1916.

Trunking supports--Continued.

- (d) Stakes supporting trunking shall be placed vertically and extend at least two (2) feet below the surface of the ground, unless otherwise specified.
- (e) A brace of spring steel (8) inches long and the width of the trunking shall be placed between the trunking and each stake.
- (f) Back joints in the bottom of the trunking shall be

108. Footings.

- Footings for track connection shall be made in accordance with the following: (a) Footings shall be securely fastened to the trunking, not less than two (2) inches from base of rail, and shall not extend more than one (1) inch above base of rail.

- (b) Junction boxes shall be made of iron or steel, and no designed flat terminals will be used. Junction boxes shall be fitted with a cover, hinge and staple.

- (c) Where ten (10) or less wires are used, junction boxes shall be six (6) inches square by twenty (20) inches deep, inside dimensions, and shall be connected to the trunking by a strap for each ten (10) wires or thereabout made in the form of a U-shape. Junction terminals shall be in accordance with R. S. A. drawing 108.

Field work.

- (1) Junction boxes shall be located as shown on the drawing and at a height of not less than six (6) feet to allow terminals to be placed at least six (6) inches above top of trunking.
- (2) Junction boxes shall be supported in the same manner as the trunking.

109. Conduits.

- (a) Fiber conduits shall be in accordance with R. S. A. specification.
- (b) Vitrified clay conduits shall be in accordance with R. S. A. specification.

Line construction.

Line construction shall conform to local laws.



715. *Line supports.*

(a) Line wire supports shall be in accordance with the following R. S. A. drawings 1089, 1165, 1166, 1219 and 1220. 1916.

(b) Aerial cable shall be supported by messenger wire. Messenger wire shall conform to R. S. A. specification and shall be supported in a manner satisfactory to the Purchaser. 1915.

(c) Cable shall be supported on messenger wire by hooks and marlin loops or by ..... 1911.

(d) Line wire supports shall be furnished in place by ..... 1911.

INSTRUMENT AND BATTERY SHELTER

718. *Cable boxes.*

(a) Cables shall terminate in cable boxes in accordance with ..... drawing ..... 1911.

(b) Cable boxes shall be furnished in place by ..... 1911.

720. *Relay boxes.*

(a) Relay boxes at signals and track circuit limits shall be in accordance with ..... drawing .....

and shall be made of  $\left\{ \begin{array}{l} \text{wood.} \\ \text{cast iron.} \\ \text{.....} \end{array} \right\}$  Cast iron boxes in

accordance with R. S. A. drawings 1182 and 1185 shall be supported as required by the Purchaser. 1915.

*Field work.*

(b) Terminals in relay boxes shall be arranged in accordance with ..... drawing ..... 1915.

721. *Relay cases.*

Relay cases for interlocking station shall be in accordance with ..... drawing ..... and shall be neatly finished and dustproof. 1911.

722. *Lightning arrester boxes.*

Boxes for housing lightning arresters shall be in accordance with ..... drawing ..... 1911.

725. *Battery chutes.*

(a) Battery chutes shall be of  $\left\{ \begin{array}{l} \text{cast iron.} \\ \text{concrete.} \end{array} \right\}$  Cast iron chutes shall be in accordance with R. S. A. drawings 1228 and 1229. 1916.

(b) Elevators for battery chutes shall be in accordance with R. S. A. drawing 1227. 1915.



728. *Battery wells and boxes.*

(a) Battery wells and boxes shall be in accordance with ..... drawing ..... 1911.

(b) Concrete battery wells shall be ..... (..) feet in diameter ..... (..) feet high, inside dimensions, and shall be water-tight. 1911.

(c) Frost neck ..... (..) feet in diameter, ..... (..) feet in height, shall be furnished for each well. 1911.

(d) Concrete battery boxes shall be ..... (..) feet ..... (..) inches by ..... (..) feet ..... (..) inches and ..... (..) feet high, inside dimensions, shall be water-tight, and shall be provided with frost protection. 1915.

(e) Durable wood covers protected by number eighteen (18) galvanized iron shall be provided. The covers shall be in accordance with ..... drawing ..... The covers shall be fastened with properly arranged chain or iron strap and provision made for locking. 1915.

(f) Shelving shall be arranged in the well in accordance with ..... drawing ..... 1915.

INSULATIONS

735. *Insulated rail joints.*

*Material.*

(a) Insulated rail joints shall be in accordance with ..... drawing ..... 1911.

*Field work.*

(b) Insulated rail joints shall be furnished by the ..... and installed by the ..... in accordance with ..... drawing ..... 1915.

738. *Switch rod insulations.*

*Material.*

(a) Switch rod insulations shall be in accordance with R. S. A. drawing 1055. 1915.

*Field work.*

(b) Switch rod insulations shall be furnished by the ..... and installed by the ..... in accordance with ..... drawing ..... 1915.

742. *Pipe line insulation.*

*Material.*

(a) Pipe line insulation shall be in accordance with R. S. A. drawing 1094. 1915.

*Field work.*

(b) Pipe line insulations shall be furnished and installed by the Contractor in accordance with ..... drawing ..... 1915.

32. Battery wells and boxes.

- (a) Battery wells and boxes shall be in accordance with the following drawing. 1915.
- (b) Concrete battery wells shall be 1.5 feet high, inside of base to top of rim, and shall be water-tight. 1915.
- (c) Frost necks shall be 1.5 feet in diameter, (1.5) feet in height, and shall be furnished for each well. 1915.
- (d) Concrete battery boxes shall be 1.5 feet high, (1.5) inches by (1.5) feet, (1.5) inches wide, (1.5) feet high, inside dimensions, shall be water-tight, and shall be provided with vent openings. 1915.
- (e) Hydraulic wood covers protected by number eight (8) galvanized iron shall be provided. The covers shall be in accordance with the following drawing. 1915.
- The covers shall be fastened with properly sized chain or iron strap and provision made for locking. 1915.
- (f) Shelving shall be cut into the wall in accordance with the following drawing. 1915.

33. Insulated rail joints.

Material.

- (a) Insulated rail joints shall be in accordance with the following drawing. 1915.

Field work.

- (b) Insulated rail joints shall be furnished by the Contractor and installed by the Signal Association. 1915.

- (a) Switch rod insulators shall be in accordance with the following drawing. 1915.

R. S. A. drawing logs.

Field work.

- (b) Switch rod insulators shall be furnished by the Contractor and installed by the Signal Association. 1915.

R. S. A. drawing logs.

Field work.

- (c) The Contractor shall be furnished with the following drawing in accordance with the following drawing. 1915.

744. *Gauge plate insulations.*

*Material.*

- (a) Gauge plate insulations shall be in accordance with  
..... drawing ..... 1916.

*Field work.*

- (b) Gauge plate insulations shall be furnished and in-  
stalled by the Contractor in accordance with .....  
drawing ..... 1916.

748. *Insulating fibre.*

- Insulating fibre shall be in accordance with R. S. A.  
specification. 1916.

PAINTING

800. *Paint.*

*Material.*

- (a) Purchaser will indicate here the kind of paint that  
shall be required: .....  
.....  
.....  
..... 1911.

*Field work.*

- (b) Surfaces covered with rust, grease, dirt or other  
foreign substances, shall be thoroughly cleaned before  
paint or oil is applied. 1911.

- (c) Paint shall not be applied to outside surfaces in  
freezing weather, nor to wet surfaces, nor until previous  
coating has thoroughly dried. 1911.

- (d) Finishing coats shall not be applied until after the  
expiration of forty-eight (48) hours after the previous  
coating has been applied. 1911.

- (e) Paints mixed on the ground shall be applied within  
three (3) hours after the pigment and oil are mixed.  
1911.

- (f) Priming coats shall be applied as soon as is con-  
sistent with the progress of the work. 1911.

- (g) Second coat shall be applied in sufficient time for  
the third coat to be applied and dry when the installation  
is completed. 1911.

- (h) Iron work (except interlocking machine, gauge  
plates, iron foundation piers), not galvanized, shall be  
painted one (1) coat of red lead and raw linseed oil and  
two (2) finishing coats. Galvanized iron pipe shall be  
painted at threads, pipe rivets and wherever galvanizing  
is damaged. 1916.



is damaged.

two (2) finishing coats. Coated iron pipe shall be painted at intervals, pipe fittings and whatever galvanized plates, iron foundation (heavy), not galvanneal, shall be painted one (1) coat of red lead and raw linseed oil and the third coat to be applied and dry when the installation is completed.

(f) Priming coats shall be applied as soon as is convenient. (g) Paint mixed on the ground shall be applied within three (3) hours after the pigment and oil are mixed.

(h) Finishing coats shall not be applied until after the expiration of forty-eight (48) hours after the previous coating has been applied.

(i) Paint shall not be applied to wet surfaces, nor until previous freezing weather, nor to wet surfaces, nor until previous painting or oil is applied.

(j) Surfaces covered with paint or oil shall be kept dry. (k) Surfaces will indicate here the kind of paint that

Material.

Insulating fibre shall be in accordance with R. S. A. Insulating fibre shall be in accordance with R. S. A.

(m) Gauge plate insulation shall be furnished and installed by the Contractor in accordance with the drawing.

(n) Gauge plate insulation shall be in accordance with the drawing.

800. *Paint.*—Continued.

(i) The following specific finishing coats shall be used:

	Kind of Paint	Color
Signal bridges and brackets	.....	.....
Signal masts	.....	.....
Dwarf signals	.....	.....
All connections	.....	.....

1911.

(j) Outside iron connections, switch and signal fittings, not machine finished, shall be dipped in raw linseed oil before shipment from works.

1911.

(k) Mechanical machine, except locking, levers and other finished parts, shall be painted one (1) coat of red lead and raw linseed oil and one (1) finishing coat of black.

1916.

(l) Unfinished part of levers and latches of mechanical machine shall be painted one (1) coat of red lead and raw linseed oil and two (2) coats of Purchaser's standard color, as follows:

	Color.
Home signal levers	.....
Distant signal levers	.....
Lock levers	.....
Other working levers	.....
Spare levers	.....
Hand releases	.....

1916.

(m) Machine for electric levers shall be of Purchaser's standard color, as follows:

	Color.
Case	.....
Home signal levers	.....
Distant signal levers	.....
Indicating lock levers	.....
Other working levers	.....
Spare levers	.....

1916.

(n) Exposed wood work shall be given one (1) priming coat and finishing coats as follows:

	Kind of Paint.	Color	Number of Coats.
Home signal blades	.....	.....	.....
Dwarf signal blades	.....	.....	.....
Distant signal blades	.....	.....	.....

Continued.

(i) The following specific finishing coats shall be used:

Kind of Paint	Color
Signal bridges and brackets	.....
Signal masts	.....
Tower signals	.....

1917

(j) Outside iron connections, switch and signal fittings not machine finished, shall be dipped in raw linseed oil before shipment from works.

Other finished parts shall be painted one (1) coat of red lead and raw linseed oil and one (1) finishing coat of black.

(l) Unfinished part of levers and bases of mechanical machine shall be painted one (1) coat of red lead and raw linseed oil and two (2) coats of Purchaser's standard

Color

Home signal levers	.....
Distant signal levers	.....
Lock levers	.....
Hand releases	.....

1918

(m) Machine for electric levers shall be of Purchaser's standard color, as follows:

Color

Indicating lock levers	.....
------------------------	-------

(n) Exposed wood work shall be given one (1) priming coat and finishing coats as follows:

Kind of Paint	Color	Number of Coats
Home signal blades	.....	.....

800. *Paint.* (n)—Continued.

	Kind of Paint.	Color.	Number of coats.
Trunking, junction boxes, etc.	.....	.....	.....
Foundation tops and bottoms	.....	.....	.....

1911.

(o) Interlocking station and other buildings, if constructed of wood, shall receive one (1) priming coat and two (2) finishing coats. The priming coat shall consist of ..... and, when thoroughly dry, two (2) coats of ....., in the following tints, shall be applied:

.....  
 .....  
 .....

1911.

900.

SPECIAL ITEMS

.....  
 .....  
 .....

1911.

925. *Locks.*

Purchaser's standard locks shall be furnished by the ..... and shall be used where specified. 1915.

926. *Number plates and numbers.*

(a) Number plates:

.....  
 .....  
 .....

1912.

(b) Numbers:

.....  
 .....  
 .....

1912.

Number

Kind of

Foundation tops and  
bottoms

(o) Interlocking station and other buildings if constructed of wood, shall receive one (1) priming coat and two (2) finishing coats. The priming coat shall consist of . . . . . and when thoroughly dry, two (2) coats of . . . . . in the following list shall be applied:

1011

Purchaser's standard locks shall be furnished by the . . . . . and shall be used where specified.

SMALL TO THE FURNISH

Number plates and numbers.  
(a) Number plates:

(b) Numbers:



## SPECIFICATIONS FOR ELECTROPNEUMATIC INTERLOCKING.

1915.

Revised 1916.

To be installed at.....  
 on the ..... R.....

### INDEX.

	Section.
Air compressors, controllers and strainers .....	62
Air pipe line .....	98
Annunciators .....	630
Arresters, lightning .....	635
boxes .....	722
Batteries, isolated .....	550 to 600
signal and line control.....	552
track .....	551
type of .....	550
Battery chutes .....	725
storage .....	85
wells and boxes .....	728
Bolts, signal foundation .....	271
Bonding .....	540 to 550
wires .....	540
Bootlegs .....	708
Boxes, junction .....	710
cable .....	718
lightning arrester .....	722
relay .....	720
Buildings .....	50 to 60
foundations .....	50
painting .....	800
Cable boxes .....	718
Case, machine .....	105
Channel pins .....	542
Chutes, battery .....	725
Circuits .....	500 to 520
electric lighting .....	506
practice .....	500
signal control .....	504
special .....	510
track .....	502
Circuits, switchboard .....	501
Common return .....	526



2  
*Railway Signal Association.*

Interlocking.  
Electro-  
Pneumatic.  
Index to  
Specifications.

	Section.
Compressor, air controllers and strainers.....	62
Concrete .....	280
Condensers .....	95
Conduits .....	711
Control apparatus .....	600 to 700
Controllers, circuit .....	610
Detail provisions .....	50 to 950
Detector bars .....	340 to 348
Distributing system .....	98 to 100
Electric lighting circuits .....	506
locks .....	615
releases .....	618
Engine .....	61
Fibre, insulating .....	748
Foundation bolts, signal.....	271
Foundations .....	270
building .....	50
Fuses .....	528
General provisions (See unit specification).	
Generator .....	65
Indication .....	103
Indicators .....	625
Instrument and battery shelters.....	720 to 735
Insulated rail joints.....	735
Insulating tests .....	40
Insulating fibre .....	748
Insulations .....	735 to 800
pipe line .....	742
switch rod .....	738
tie plate .....	744
Interlocking machine .....	100 to 270
station .....	51
Iron work, painting.....	800
Joints in wire .....	527
rail, insulated .....	735
trunking .....	703
Junction boxes .....	710
Lamps .....	430
Levers .....	102
Lighting .....	54
Lightning arrester boxes .....	722
arresters .....	635
Line construction .....	714
Line control .....	552
Line supports .....	715



	Section.
Locking .....	101
Lock rods .....	312
Locks .....	925
electric .....	615
Machine, interlocking .....	100
painting .....	800
Mechanical connections .....	301
Mercury arc rectifier .....	81
Motor .....	70
Motor generator .....	75
Number plates .....	926
Painting .....	800
buildings .....	800
iron work .....	800
machine .....	800
wood work .....	800
Petroleum asphaltum .....	532
Pins, channel .....	542
Pipe line insulation.....	742
Power house .....	52
plant .....	61
supply .....	60 to 98
Rail joints, insulated .....	735
Rectifier .....	81
Relays .....	600
boxes .....	720
cases .....	721
Releases .....	618
Releases, time .....	619
Rocking shafts and fittings.....	345
Roundels .....	425
Section locking circuits.....	348
Signal control .....	504
Signals, type and assembly.....	400 to 500
Signal and line control.....	552
Special circuits .....	510
items .....	900 to 950
Storage battery .....	85
Supports, line .....	715
trunking .....	705
Switchboards and equipments.....	90
circuits .....	501
Switches .....	300 to 340
Switch mechanism .....	300
rod insulations .....	738



101	.....	.....
102	.....	.....
103	.....	.....
104	.....	.....
105	.....	.....
106	.....	.....
107	.....	.....
108	.....	.....
109	.....	.....
110	.....	.....
111	.....	.....
112	.....	.....
113	.....	.....
114	.....	.....
115	.....	.....
116	.....	.....
117	.....	.....
118	.....	.....
119	.....	.....
120	.....	.....
121	.....	.....
122	.....	.....
123	.....	.....
124	.....	.....
125	.....	.....
126	.....	.....
127	.....	.....
128	.....	.....
129	.....	.....
130	.....	.....
131	.....	.....
132	.....	.....
133	.....	.....
134	.....	.....
135	.....	.....
136	.....	.....
137	.....	.....
138	.....	.....
139	.....	.....
140	.....	.....
141	.....	.....
142	.....	.....
143	.....	.....
144	.....	.....
145	.....	.....
146	.....	.....
147	.....	.....
148	.....	.....
149	.....	.....
150	.....	.....
151	.....	.....
152	.....	.....
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154	.....	.....
155	.....	.....
156	.....	.....
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163	.....	.....
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166	.....	.....
167	.....	.....
168	.....	.....
169	.....	.....
170	.....	.....
171	.....	.....
172	.....	.....
173	.....	.....
174	.....	.....
175	.....	.....
176	.....	.....
177	.....	.....
178	.....	.....
179	.....	.....
180	.....	.....
181	.....	.....
182	.....	.....
183	.....	.....
184	.....	.....
185	.....	.....
186	.....	.....
187	.....	.....
188	.....	.....
189	.....	.....
190	.....	.....
191	.....	.....
192	.....	.....
193	.....	.....
194	.....	.....
195	.....	.....
196	.....	.....
197	.....	.....
198	.....	.....
199	.....	.....
200	.....	.....

	Section.
Tags .....	530
Terminal board .....	104
Tie plate insulations .....	744
Time releases .....	619
Track batteries .....	551
circuits .....	502
Transformers .....	80
Trunking .....	700
conduit and supports.....	700 to 720
supports .....	705
joints .....	703
Type and assembly of signals.....	400
Wells, battery .....	728
Wire and wiring .....	520 to 540
bonding .....	540
joints .....	527
sizes .....	521
specifications .....	520
Wiring .....	525
Wood work, painting .....	800

1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10	10	10
11	11	11
12	12	12
13	13	13
14	14	14
15	15	15
16	16	16
17	17	17
18	18	18
19	19	19
20	20	20
21	21	21
22	22	22
23	23	23
24	24	24
25	25	25
26	26	26
27	27	27
28	28	28
29	29	29
30	30	30
31	31	31
32	32	32
33	33	33
34	34	34
35	35	35
36	36	36
37	37	37
38	38	38
39	39	39
40	40	40
41	41	41
42	42	42
43	43	43
44	44	44
45	45	45
46	46	46
47	47	47
48	48	48
49	49	49
50	50	50
51	51	51
52	52	52
53	53	53
54	54	54
55	55	55
56	56	56
57	57	57
58	58	58
59	59	59
60	60	60
61	61	61
62	62	62
63	63	63
64	64	64
65	65	65
66	66	66
67	67	67
68	68	68
69	69	69
70	70	70
71	71	71
72	72	72
73	73	73
74	74	74
75	75	75
76	76	76
77	77	77
78	78	78
79	79	79
80	80	80
81	81	81
82	82	82
83	83	83
84	84	84
85	85	85
86	86	86
87	87	87
88	88	88
89	89	89
90	90	90
91	91	91
92	92	92
93	93	93
94	94	94
95	95	95
96	96	96
97	97	97
98	98	98
99	99	99
100	100	100

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SPECIFICATIONS FOR ELECTROPNEUMATIC  
INTERLOCKING.

1915.

Revised 1916.

GENERAL PROVISIONS OF SPECIFICATIONS FOR  
SIGNAL INSTALLATIONS.

(See unit specification covering the text of these provisions indexed  
under Subdivision G.)

*Note.*—This unit specification has been adopted as of January 10,  
1917, to take the place of the "General Provisions," heretofore form-  
ing a part of these specifications. This sheet is numbered 1 to 6, in  
order to obviate the necessity of having the existing subject matter  
reprinted.

General Electrical Requirements.\*

40. *Insulating tests.*

(a) Unless otherwise stated, electrical terms, ratings  
and tests shall be in accordance with the Standardization  
Rules of the American Institute of Electrical Engineers.

1915.

(b) Except when otherwise specified, electrical ap-  
paratus shall withstand a dielectric test of two thousand  
(2,000) volts, effective value, a.c. for one (1) minute at  
the place of manufacture.

1915.

---

\*It will be noted that Section 30, General Electrical Requirements  
in other major specifications, is Section 40 in Electropneumatic  
Interlocking Specifications.

# INTERPRETING

## GENERAL PROVISIONS OF SPECIFICATIONS FOR JOURNAL INSTALLATIONS

See unit specification covering the text of these provisions, referred  
under Subdivision C.

Note—This unit specification has been adopted as of January 1917  
to take the place of the "General Provisional" heretofore forming  
a part of these specifications. This sheet is numbered 1 to 6, in  
order to obviate the necessity of having the entire subject matter  
printed.

REMARKS

REMARKS

(a) Unless otherwise stated, electrical terms, ratings  
and tests shall be in accordance with the Standardization  
Rules of the American Institute of Electrical Engineers.  
1917.

(b) Except when otherwise specified, electrical ap-  
paratus shall withstand a dielectric test of two thousand  
(2,000) volts, effective value, for one (1) minute at  
the place of manufacture.  
1917.

It will be noted that Section 30, General Electrical Requirements,  
for major specifications, is Section 40 in Electrophysics.



40. *Insulating tests.—Continued.*

(c) Magnets and solenoids shall be plainly marked with their resistance and the size of wire with which they are wound. 1915.

(d) Windings shall be treated in accordance with R. S. A. specification for "Impregnation Treatment of Coils and Windings." 1916.

**DETAIL PROVISIONS.**

BUILDINGS

50. *Foundations.*

(a) Foundations shall be provided by the ..... in accordance with specifications and drawings ..... dated ..... 1916.

(b) The foundation for interlocking station leadout supports shall be furnished in place by the ..... in accordance with R. S. A. drawings 1200, 1203, or 1217. 1916.

51. *Interlocking station.*

Building shall be provided by the ..... in accordance with specifications and drawings ..... dated ..... 1916.

52. *Power house.*

Building shall be provided by the ..... in accordance with specifications and drawings ..... dated ..... 1916.

54. *Lighting.*

(a) The lighting for buildings shall be installed by ..... 1911.

(b) The type of fixtures, number, kind, size and switch control of electric lamps shall be in accordance with ..... specifications and drawing ..... dated .....; lamps distributed as follows:

	Number.	Watts per Lamp.
Operating room	..... (..)	..... (..)
Tower room	..... (..)	..... (..)
Battery room	..... (..)	..... (..)
Generator room	..... (..)	..... (..)
Special	..... (..)	..... (..)

1916.

(c) Fixtures for electric lighting shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

(c) Magnets and solenoids shall be plainly marked

(d) Windings shall be treated in accordance with S. A. specification for "Impregnation Treatment of Coils and Windings," 1916.

### DETAILS OF CONSTRUCTION

(a) Foundations shall be provided by the building in accordance with specifications and drawings dated 1916.

(b) Foundations shall be furnished in place by the building in accordance with S. A. specification for "Foundations," 1916.

(c) Building shall be provided by the building in accordance with specifications and drawings dated 1916.

(d) Building shall be provided by the building in accordance with specifications and drawings dated 1916.

(e) The lighting for buildings shall be installed by the building in accordance with specifications and drawings dated 1916.

(f) The type of fixtures, number, kind, size and switch control of electric lamps shall be in accordance with specifications and drawings dated 1916.

Operating room	( )
Tower room	( )

(g) Fixtures for electric lighting shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities, 1916.

54. *Lighting.*—Continued.

(d) Fixtures and accessories for electric lamps shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities. 1916.

POWER SUPPLY

60. *Plant.\**

(a) The power plant shall consist of ..... 1916.

(b) ..... shall be furnished by ..... and installed by ..... 1916.

(c) ..... shall be furnished by ..... and installed by ..... 1916.

61. *Engine.*

(a) A ..... (..) cylinder ..... (..) cycle { vertical } { steam } engine of ..... (..) { horizontal } { air } { turbine } brake horse-power, manufactured by ....., installed by ....., the ..... shall be furnished on a ..... foundation, to be furnished in place by the ....., constructed in accordance with the standard specification of the ..... and drawings of the Manufacturer of the engine numbers ....., dated ..... 1916.

(b) Gasoline engines, fuel and water tanks shall conform to R. S. A. specifications. 1916.

(c) Engines shall be of such type as to be easily accessible for attention to bearings, adjusting and cleaning. 1916.

(d) Contractor shall furnish sufficient material for installation of muffler outside of building with as few turns and bends as practicable. 1916.

(e) A complete set of wrenches shall be furnished. 1911.

(f) Exposed piping subject to excessive heat shall be protected with { asbestos } covering. 1916.  
{ ..... }

---

\*R. S. A. drawings 1388 and 1389 may be used as guides in determining the parts of each plant, which may then be specified in Section 60.

(b) Wires and accessories for electric lamps shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities.

# POWER SUPPLY

(a) The power plant shall consist of . . . . .

1910

shall be furnished by . . . . . and installed

1910

1910

(a) A . . . . . cylinder . . . . .

brake horse-power, manufactured by . . . . . in-  
stalled by . . . . . the . . . . . shall be fur-  
nished on a . . . . . foundation to be furnished in  
accordance with the . . . . . constructed in accordance  
with the standard specification of the . . . . . and  
drawings of the Manufacturer or the engine number  
dated . . . . . 1910

(b) Gasoline engines, fuel and water tanks shall be  
in accordance with R. S. A. specifications. 1910

(c) Engines shall be of such type as to be easily ac-  
cessible for attention to bearing, adjusting and cleaning. 1910

(d) Condenser shall be of such resistant material for in-  
stallation of cooler outside of building with as few turns

(e) A complete set of wrenches shall be furnished. 1910

(f) Exposed piping subject to excessive heat shall be  
protected with . . . . . covering. 1910

R. S. A. drawings 1388 and 1389 may be used as guides  
in determining the parts of each engine, which may then be  
specified in Section 60.

62. *Air compressors, controllers and strainers.*

(a) A  $\left\{ \begin{array}{l} \text{one} \\ \text{two} \end{array} \right\}$  stage air compressor with a capacity of  
..... (..) cubic feet of free air per minute at  
..... (..) revolutions per minute at .....  
(..) elevation above sea level and designed for air pres-  
sure of ..... (..) pounds, manufactured by .....  
....., installed by the ....., shall be fur-  
nished on a ..... foundation, to be furnished in  
place by the ....., constructed in accordance with  
the specifications which shall be attached to the Con-  
tractor's bid. 1915.

(b) Automatic controllers shall be provided by the  
..... and shall be arranged to cut in the com-  
pressor at ..... (..) pounds and cut out at ....  
..... (..) pounds pressure. 1915.

(c) An air strainer of a design which shall be approved  
by the Purchaser, shall be installed in each air intake  
pipe. 1915.

65. *Generator.*

The electric generator shall be in accordance with  
R. S. A. specification. 1916.

70. *Motor.*

The motor shall be ..... (..) K.W. approx.  
equiv. .... (..) horsepower with a rated speed  
not to exceed ..... (..) r.p.m., if direct current,  
or one thousand eight hundred (1800) r.p.m., if alter-  
nating current, and shall have automatic regulation to  
within ..... per cent. when operating on .....  
..... (..) to ..... (..) volts d.c., or on  
..... (..) to ..... (..) volts, .....  
(..) cycles ..... phase a.c., shall be in accordance  
with R. S. A. specification for "Electric Generator"  
regarding heating, sparking and insulation, and shall be  
furnished with a starting panel. 1916.





75. *Motor generator.*

Motor generator shall be ..... connected,  
mounted on a cast iron sub-base and shall conform to  
R. S. A. specifications for "Motors" and "Generators"  
(Sections 65 and 70). 1911.

80. *Transformer.*

Transformer shall be in accordance with { R. S. A. }  
specification. { ..... } 1916.

81. *Mercury arc rectifier.*

Mercury arc rectifier shall conform to  
{ R. S. A. drawing 1242 } and shall be of .....  
{ ..... }  
(...) d.c. ampere capacity, with d.c. voltage regulation be-  
tween ..... (..) and ..... (..) volts.  
Rectifier shall be designed to be operated from a single  
phase a.c. supply of ..... (..) volts and .....  
..... (..) cycles without over-heating and causing  
permanent deterioration of its insulation when operated  
at maximum capacity. 1915.

85. *Storage battery.*

(a) Storage batteries shall consist of ..... (..) cells ..... (..) ampere hour capacity of the  
{ Lead }  
{ Nickel, iron, alkaline } type and shall be in accordance  
with R. S. A. specification. 1916.

(b) Lead type storage battery shall be in accordance  
with R. S. A. drawings 1224, 1241, 1340 and 1341. 1915.

(c) The installation of storage batteries shall conform  
to R. S. A. directions. 1916.

(d) For each plant where lead type batteries are used  
one (1) hydrometer, one (1) thermometer and two (2)  
extra jars shall be provided by the ..... 1915.



300. *Switch mechanism.*—Continued.

(g) The location of switch operating mechanism shall be as shown on ..... drawing .....  
dated ..... 1916.

(h) Parts of mechanisms and covers shall be placed outside of clearance limits, as shown on .....  
drawing ..... , dated ..... 1916.

301. *Mechanical connections.*

(a) All mechanical connections shall be in accordance with R. S. A. specifications for "Mechanical Interlocking." 1916.

(b) Arrangement and support of connections shall be such that switch points can be stopped by placing an obstruction between point and stock rail at any part of stroke, without breaking or bending any connections; also shall be strong enough to prevent bending or breaking in case mechanism is operated when detector bar is engaged by wheels of a car or engine. 1911.

(c) Both the operating and the lock rod shall be of sufficient strength to alone and independently hold the switch points in position. 1911.

312. *Lock rods.*

(a) A rectangular lock rod shall be used, with a vertical locking face of a height as great as practicable. 1911.

(b) Notches in lock rods and the end of locking dogs shall have square edges, and the notches shall be not more than one-sixteenth ( $1/16$ ) inch larger than the locking dog, measured in a horizontal line. 1915.

DETECTOR BARS

340. *Detector bars.*

*Material.*

(a) Detector bars and driving pieces shall be in accordance with R. S. A. drawing 1098. 1915.

(b) Rail clips shall be in accordance with R. S. A. drawing 1099. 1915.

*Field work.*

(c) Bars shall be located as shown on .....  
drawing ..... , unless otherwise specified. 1911.

(d) Detector bars shall be arranged to give .....  
(...) feet continuous protection for all switches, derails,  
movable wing frogs, and movable point frogs. 1911.





340. *Detector bars.*—Continued.

(e) Detector bars, when practicable, shall be so connected that the unlocking movement when switch is in the main line position shall be in reverse direction to the facing movement of traffic over the points. 1915.

(f) Fifty-three (53) feet bars shall be mounted on sixteen (16) rail clips and a proportionate number of clips shall be used for longer or shorter bars. 1911.

(g) Center of rail clips shall be placed eight (8) inches and twenty-six (26) inches, respectively, from end and the remaining clips approximately three (3) feet nine (9) inches apart. 1915.

(h) Bars shall rise a minimum of three-fourths ( $\frac{3}{4}$ ) inch above top of rail at every point during the locking and unlocking of the switch, and shall rest one-fourth ( $\frac{1}{4}$ ) inch below top of rail at every point when lever travel is completed. 1911.

(i) Driving pieces shall be placed midway between two (2) clips in space not occupied by joint in bar, and the driving rod shall have a length of not more than seven (7) feet unsupported. 1915.

345. *Rocking shafts and fittings.*

*Material.*

(a) Rocking shafts and fittings shall be in accordance with R. S. A. drawings 1060, 1061 and 1063. 1916.

*Field work.*

(b) Rocking shaft bearers shall be securely bolted to ties with four (4) three-fourths ( $\frac{3}{4}$ ) inch bolts. The maximum spacing of bearers shall be six (6) feet centers. 1915.

348. *Section locking circuits.*

Section locking circuits  $\left\{ \begin{array}{l} \text{will} \\ \text{will not} \end{array} \right\}$  be required in  
 $\left\{ \begin{array}{l} \text{addition to} \\ \text{lieu of} \end{array} \right\}$  detector bars. 1914.

SIGNALS

400. *Type and assembly.*

(a) Signals shall be of the semaphore or ..... type. Semaphore signals shall have an arm travel of ..... (..) degrees in the .....  $\left\{ \begin{array}{l} \text{right} \\ \text{left} \end{array} \right\}$  quadrant. 1916.

(e) Detector bars when practicable shall be so connected that the unlocking movement when switch is in the main line position shall be in reverse direction to the facing movement of train over the points.

(f) Center of rail clips shall be placed eight (8) inches and twenty-six (26) inches respectively from end and the remaining clips approximately three (3) feet nine (9) inches apart.

(g) Bars shall rise a minimum of three-fourths (3/4) inch above top of rail at every point during the locking and unlocking of the switch, and shall rest one-fourth (1/4) inch below top of rail at every point when lever travel is completed.

(h) Driving pieces shall be placed midway between two (2) clips in space not occupied by joint in bar, and the driving rod shall have a length of not more than seven (7) feet unsupported.

(i) Locking shanks and fittings shall be in accordance with R. S. A. drawings, rods, rods and rods.

(j) Locking shanks and fittings shall be in accordance with R. S. A. drawings, rods, rods and rods.

(k) Locking shanks and fittings shall be in accordance with R. S. A. drawings, rods, rods and rods.

(l) Locking shanks and fittings shall be in accordance with R. S. A. drawings, rods, rods and rods.

(m) Locking shanks and fittings shall be in accordance with R. S. A. drawings, rods, rods and rods.

(n) Locking shanks and fittings shall be in accordance with R. S. A. drawings, rods, rods and rods.

(o) Locking shanks and fittings shall be in accordance with R. S. A. drawings, rods, rods and rods.

(p) Locking shanks and fittings shall be in accordance with R. S. A. drawings, rods, rods and rods.

(q) Locking shanks and fittings shall be in accordance with R. S. A. drawings, rods, rods and rods.

(r) Locking shanks and fittings shall be in accordance with R. S. A. drawings, rods, rods and rods.

(s) Locking shanks and fittings shall be in accordance with R. S. A. drawings, rods, rods and rods.

WIRE AND WIRING

520. *Specifications.*

Wire and cable shall be in accordance with R. S. A. specifications. 1916.

521. *Size.*

(a) Wires shall be of sufficient size to permit operation of switch and signal mechanism in accordance with previous specifications. 1911.

(b) Single conductor wires external to the interlocking station shall not be smaller than number fourteen (14) American Wire Gauge. Single conductor wires within the interlocking station shall not be smaller than number sixteen (16) American Wire Gauge. 1915.

(c) Wires in cable external to the interlocking station shall not be smaller than number sixteen (16) American Wire Gauge. 1915.

(d) Hard drawn copper or copper clad line wire shall not be smaller than number twelve (12) American Wire Gauge. 1915.

(e) No common return wire shall be less than number twelve (12) American Wire Gauge. 1915.

(f) In cable work, spare wires shall be provided as specified. When spare wires are required in other than cable work, the number and size shall be specified. 1915.

(g) Numbers and sizes of track circuit connections to each rail shall be as follows:

	No. of Conductors	American Wire Gauge
1. Track transformers or batteries to rail....	one (1)	..... (..)
2. Relay to each rail....	one (1)	..... (..)
3. Fouling shunt connections .....	two (2)	..... (..)
4. Switch circuit controller shunt connections .....	two (2)	..... (..)
5. Wire from trunking to track batteries in chutes, stranded ...	... (.)	..... (..)

1916.

(h) Wires connected to track shall be rubber-covered, soft-drawn copper. 1915.

WIRE AND WIRING

220. Specifications.

Wire and cable shall be in accordance with R. S. A. specifications.  
1916.

221. Size.

(a) Wires shall be of sufficient size to permit operation of switch and signal mechanism in accordance with specifications.

(b) Single conductor wires external to the interlocking station shall not be smaller than number fourteen (14) American Wire Gauge. Single conductor wires within the interlocking station shall not be smaller than number sixteen (16) American Wire Gauge.  
1915.

(c) Wires in cable external to the interlocking station shall not be smaller than number sixteen (16) American Wire Gauge.  
1915.

(d) Hard drawn copper or copper clad line wire shall not be smaller than number twelve (12) American Wire Gauge.

(e) No common return wire shall be less than number twelve (12) American Wire Gauge.  
1915.

(f) In cable work wires shall be specified in terms of size and number. When spare wires are required in other than cable work, the number and size shall be specified.  
1915.

(g) Numbers and sizes of track circuit connections to each rail shall be as follows:

No. of American Wire	
1. Track transformers or batteries to rail	one (1)
2. Relay to each rail	one (1)
3. Fanning shunt connections	two (2)
4. Switch circuit connections	two (2)
5. Wire from running track batteries in	one (1)
6. Wires connected to track shall be rubber-covered.	one (1)

525. *Wiring.*

- (a) Wires in trunking, chases or conduits shall be laid loosely without stretching or crowding. 1911.
- (b) Not more than two (2) wires shall be connected to one (1) binding post or terminal screw. 1911.

526. *Common return.*

- (a) Unless otherwise specified, common return wires shall be continuous without joints between home and dwarf signal limits. 1915.
- (b) Connections between branches and main common wires shall be made in junction boxes. 1911.
- (c) Reductions in size of common wire and connections to pole lines shall be made in junction boxes. 1911.

527. *Joints in wire.*

- (a) Wires shall, as far as practicable, be continuous without joints between interlocking machine and the unit operated; joints when made shall be in junction boxes, and only made with permission from the Purchaser's representative. 1915.
- (b) In making joints, braid shall be removed for a distance of one (1) inch from end of rubber on each side of joint, and rubber cut with knife held at an angle of approximately thirty (30) degrees with axis of wire, as one would sharpen a pencil, care being taken to prevent injury from small cuts or nicks. 1915.
- (c) Wire, after being cleaned, shall be twisted together in the form of a regular line wire ("Western Union joint"), turns being spaced approximately one-sixty-fourth ( $1/64$ ) inch, or ..... 1915.
- (d) The branch wire, after being cleaned, shall be wrapped around main wire, turns being spaced approximately one-sixty-fourth ( $1/64$ ) inch. 1915.
- (e) Joints shall then be soldered by pouring on them, or dipping them into melted solder, a non-corrosive flux being used. After soldering, joints shall be covered with two (2) layers of rubber insulating tape between ends of braid, which tape shall be heated sufficiently to form a tight covering, but not enough to injure the quality of the material; insulating tape shall be in accordance with



2108

715

527. *Joints in wire.*—Continued.

R. S. A. specification for "Rubber Insulating Tape." Two (2) layers of friction tape shall be applied over the rubber insulation and the ends of the braiding, and this tape shall then be thoroughly coated with black asphaltum paint. The friction tape shall be in accordance with R. S. A. specification for "Friction Tape." 1916.

528. *Fuses.*

*Material.*

(a) Fuses shall be of the enclosed type, in accordance with R. S. A. drawing 1309. Fuse clips shall be mounted on an insulating base of fireproof material. 1915.

*Field work.*

(b) The necessary fuses to properly protect all apparatus and circuits, as required by the Purchaser, shall be installed. 1915.

(c) Fuses outside of buildings shall be enclosed in weatherproof boxes. 1911.

530. *Tags.*

Wires shall be identified at all terminals, by means of a non-metallic tag or label, on which is stamped the wire designation corresponding to that shown on the circuit and wiring plan. Where practicable, the tags shall be securely fastened adjacent to the terminal, so that the number can be easily read. 1915.

532. *Petroleum asphaltum.*

*Material.*

(a) Petroleum asphaltum shall be in accordance with R. S. A. specification. 1916.

*Field work.*

(b) When specified, the wires in trunking shall be loosely bound and shall be so laid in pitch as to be practically free of contact with all walls of the trunking. 1911.

(c) When petroleum asphaltum is used, terminal box bootlegs, trunking and bootleg terminals shall be in accordance with R. S. A. drawings 1154, 1155, 1156 and 1157. 1915.



BONDING

540. *Bonding wires.*

*Material.*

(a) Bonding wires shall be in accordance with R. S. A. specification. 1916.

*Field work.*

(b) Bonding shall be in accordance with ..... drawing ..... Rail joints shall be bonded with two { E. B. B. copper clad copper } bonding wires, except where joints

are located in station platforms, road crossings or tunnels, in which cases, each joint shall be bonded either with 4 E. B. B. wires, two being placed on either side of the rail, outside of the angle bar, or with two (2) number six (6) American Wire Gauge, bare copper or copper-clad steel bonding wires. 1915.

(c) Frogs shall be bonded in the same manner as the rail joints and shall be so connected, that the continuity of the track circuit will be broken when they are removed from the track. 1915.

542. *Channel pins.*

*Material.*

(a) Channel pins shall be in accordance with R. S. A. specification. Single channel pins shall be in accordance with R. S. A. drawing 1086. 1916.

*Field work.*

(b) Each bond wire shall be fastened at each end into the web of the rail by a channel pin. 1911.

(c) Bonding shall be completed the same day that holes are drilled. 1911.

ISOLATED BATTERIES

550. *Type of battery.*

*Material.*

Batteries shall be of the { primary storage } type and shall be in accordance with R. S. A. specification for

{ Caustic Soda Primary Battery.  
Pure Lead Type Stationary Storage Battery.  
Lead Type Portable Storage Battery.  
Nickel, Iron, Alkaline Storage Battery. }

1915.





800. *Paint,—Continued.*

(j) Outside iron connections, switch and signal fittings, not machine finished, shall be dipped in raw linseed oil before shipment from works. 1915.

(k) Machine and lever handles shall be of Purchaser's standard color, as follows:

	Color
Case	.....
Home signal levers	.....
Distant signal levers	.....
Switch levers	.....
Other working levers	.....
Spare levers	..... 1915.

(l) Exposed wood work shall be given one (1) priming coat and finishing coats as follows:

	Kind of paint	Color	Number of coats
Home signal blades	.....	.....	.....(..)
Dwarf signal blades	.....	.....	.....(..)
Distant signal blades	.....	.....	.....(..)
Trunking, junction boxes, etc.	.....	.....	.....(..)
Foundation tops and bottoms	.....	.....	.....(..)
			1915.

(m) Interlocking station and other buildings, if constructed of wood, shall receive one (1) priming coat and two (2) finishing coats. The priming coat shall consist of ..... and, when thoroughly dry, two (2) coats of ..... in the following tints, shall be applied:  
.....  
.....  
.....  
1915.

SPECIAL ITEMS

900.

.....  
.....  
.....  
1911.

925. *Locks.*

Purchaser's standard locks shall be furnished by the ..... and shall be used where specified. 1915.

Continued.

- (j) Outside iron connections, switch and signal fittings for shipment from works.
- (k) Machine and lever handles shall be of Pritchard's standard color, as follows:

Color

Machine signal levers	Black
Switch levers	Red
Other working levers	Blue

- (l) Exposed wood work shall be given one (1) primer coat and finishing coats as follows:

Kind of wood	Color of primer	Color of finish
Horizontal signal blades	Black	Black
Vertical signal blades	Black	Black
Horizontal signal blades	Black	Black
Foundation tops and bottoms	Black	Black

(m) Interlocking station and other buildings shall be painted with wood shall receive one (1) priming coat and two (2) finishing coats. The priming coat shall consist of ... and when thoroughly dry, two (2) coats of ... in the following tint, shall be applied:

Pritchard's standard colors shall be furnished by the ... and shall be used where specified.

926. *Number plates and numbers.*

(a) Number plates:

.....  
.....  
.....

1912.

(b) Numbers:

.....  
.....  
.....

1912.

(a) Number of pages

1914

(b) Number of

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SPECIFICATIONS FOR MECHANICAL INTERLOCKING.

1916.

To be installed at.....  
on the ..... R.....

*INDEX.*

	Section.
Adjustments, pipe (See leadout and groundwork).....	235
Bars, deflecting (See leadout and groundwork).....	203
Bars, detector (See switches).....	340
Bolt locks (See switches).....	313
Bolts, screws and washers (See leadout and groundwork).....	261
Boxes, stuffing (See leadout and groundwork).....	212
Boxing (See foundations).....	290
Braces, rail (See switches).....	322
Building .....	50 to 100
foundations .....	50
interlocking station .....	51
lighting .....	54
power house .....	52
Carriers, pipe (See leadout and groundwork).....	213
Circuits, section locking (See switches).....	348
Compensators (See leadout and groundwork).....	220
Concrete (See foundations).....	280
Connections, mechanical (See switches).....	301
Cranks (See leadout and groundwork).....	202
Deflecting bars (See leadout and groundwork).....	203
Detector bars (See switches).....	340
Facing point locks (See switches).....	310
Foundations .....	270 to 300
foundations .....	270
concrete .....	280
boxing .....	290
Foundations (See buildings).....	50
Gauge, butt and riser plates (See switches).....	320
House, power (See buildings).....	52
Interlocking machine .....	100 to 200
levers .....	102
locking .....	101
machine .....	100
Jaws and lugs (See leadout and groundwork).....	230
Lamps (See signals).....	430





	Section.
Leadout and groundwork.....	200 to 300
bolts, screws and washers.....	261
compensators .....	220
cranks .....	202
deflecting bars .....	203
jaws and lugs.....	230
leadout .....	200
pins .....	260
pipe adjustments .....	235
pipe and pipe lines.....	210
pipe carriers .....	213
rocking shaft and fittings.....	206
stuffing box .....	212
Levers (See interlocking machine).....	102
Lighting (See buildings).....	54
Locks .....	925
Locks, bolt (See switches).....	313
Locks, facing point (See switches).....	310
Lock rods (See switches).....	312
Locking (See interlocking machine).....	101
Lugs, jaws and (See leadout and groundwork).....	230
Machine (See interlocking machine).....	100
Mechanical connections (See switches).....	301
Number plates and numbers.....	926
Paint .....	800
Pins (See leadout and groundwork).....	260
Pipe adjustments (See leadout and groundwork).....	235
Pipe and pipe lines (See leadout and groundwork).....	210
Pipe carriers (See leadout and groundwork).....	213
Plates, gauge, butt and riser (See switches).....	320
Power house (See buildings).....	52
Rail braces (See switches).....	322
Rocking shafts and fittings (See leadout and groundwork).....	206
Rods, lock (See switches).....	312
Roundels (See signals).....	425
Section locking circuits (See switches).....	348
Signals .....	400 to 430
lamps .....	430
roundels .....	425
type .....	400
Station, interlocking (See buildings).....	51
Straps, tie (See switches).....	320
Stuffing boxes (See leadout and groundwork).....	212



	Section.
Switches .....	300 to 400
bolt locks .....	313
detector bars .....	340
facing point locks.....	310
gauge, butt and riser plates.....	320
lock rods .....	312
mechanical connections .....	301
rail braces .....	322
section locking circuits.....	348
switch mechanism .....	300
tie straps .....	330
Tie straps (See switches).....	330
Type (See signals).....	400

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14

152

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SPECIFICATIONS FOR MECHANICAL INTERLOCKING.  
1916.

DETAIL PROVISIONS.

BUILDINGS

50. *Foundations.*

(a) Foundations shall be provided by the .....  
in accordance with specifications and drawings .....,  
dated ..... 1916.

(b) The foundation for interlocking station leadout  
supports shall be furnished in place by the .....  
in accordance with R. S. A. drawings 1200, 1203, or 1217.  
1916.

51. *Interlocking station.*

Building shall be provided by the ..... in ac-  
cording with specifications and drawings ....., dated  
..... 1916.

52. *Power house.*

Buildings shall be provided by the ..... in ac-  
cording with specifications and drawings ....., dated  
..... 1916.

54. *Lighting.*

(a) The lighting for buildings shall be installed by  
..... 1911.

(b) The type of fixtures, number, kind, size and switch  
control of electric lamps shall be in accordance with ....  
..... specifications and drawing .....,  
dated .....; lamps distributed as follows:

	Number.	Watts per Lamp.
Operating room	..... (..)	..... (..)
Tower room	..... (..)	..... (..)
Battery room	..... (..)	..... (..)
Generator room	..... (..)	..... (..)
Special	..... (..)	..... (..)

1916.

(c) Fixtures for electric lighting shall be in accord-  
ance with the rules of the National Board of Fire Under-  
writers and the requirements of local authorities. 1916.

(d) Fixtures and accessories for electric lamps shall  
be in accordance with the rules of the National Board of  
Fire Underwriters and the requirements of local authori-  
ties. 1916.

1916

1916

1916

(a) Foundations shall be provided by the building owner in accordance with specifications and drawings.

(b) The foundation for interlocking station building shall be provided in place by the building owner in accordance with R. E. A. drawings 1200, 1201, or 1217.

Interlocking station.

Buildings shall be provided by the building owner in accordance with specifications and drawings dated 1916.

Power house.

Buildings shall be provided by the building owner in accordance with specifications and drawings dated 1916.

Lighting.

(a) The lighting for buildings shall be installed by the building owner.

(b) The type of fixture, number, kind, size and switch control of electric lamps shall be in accordance with specifications and drawings dated 1916.

Watts per lamp	Number	
( )	( )	Operating room
( )	( )	Power house
( )	( )	Station room
( )	( )	
( )	( )	Special
1916		

(c) Fixtures for electric lighting shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities.

(d) Fixtures and accessories for electric lamps shall be in accordance with the rules of the National Board of Fire Underwriters and the requirements of local authorities.

INTERLOCKING MACHINE

100. *Machine.*

- (a) Levers shall be numbered and arranged in accordance with drawing ....., dated ..... 1915.
- (b) Like parts of machine of same type shall be interchangeable. 1914.
- (c) All bolts, tap bolts and set screws shall be provided with jam nuts or nut locks where it is practicable to apply them. 1914.
- (d) One lever shoe pin and cap shall be provided for each spare space. 1911.
- (e) One (1) mechanical lever shall not operate more than:
  - 1. One (1) mechanical signal. 1914.
  - 2. Two (2) pairs of switch points. 1914.
  - 3. Two (2) full length detector bars. 1914.
  - 4. Two (2) switch and lock movements and one (1) full length detector bar. 1914.
  - 5. Two (2) eight (8) way mechanical bridge couplers. 1914.
  - 6. The combination of rail locks, bridge locks, mechanical bridge couplers and electric bridge couplers when the total load of such combination exceeds the load of two (2) eight (8) way mechanical bridge couplers. 1914.

101. *Locking.*

- (a) Machine shall be provided with mechanical locking of the preliminary type. 1911.
- (b) For each lever and each spare space, depending upon the type of machine, provision shall be made in the locking bed for space to accommodate either:
  - 1. One (1) locking shaft with one (1) cross locking bar and one (1) longitudinal locking bar for the full length of the machine. 1916.
  - 2. One (1) tappet with one (1) longitudinal locking bar for the full length of the machine. 1916.
- (c) Locking shall be distributed as uniformly as possible in the locking bed and so arranged as to be easily accessible. 1911.
- (d) Each end of locking shafts of Saxby and Farmer type shall be square and of like dimensions. 1914.
- (e) The front, back and intermediate rails supporting locking bed of Saxby & Farmer type shall be provided with one way caps. 1911.

(c) Level: all the measured and changed in level

(d) The point of measuring of some of the shall be measured

(e) All holes and pits and set screws shall be filled with putty and the level shall be applied to the surface

(f) One inch of a pin and cap shall be provided in each of the above

(g) One (1) mechanical level shall be used

(h) One (1) mechanical level shall be used

(i) Two (2) points of level shall be used

(j) Two (2) fall length detector shall be used

(k) Two (2) fall length detector shall be used

(l) Two (2) fall length detector shall be used

(m) Two (2) fall length detector shall be used

(n) Two (2) fall length detector shall be used

(o) Two (2) fall length detector shall be used

(p) Two (2) fall length detector shall be used

(q) Two (2) fall length detector shall be used

(r) Two (2) fall length detector shall be used

(s) The level shall be used in a level which shall be used

(t) The level shall be used in a level which shall be used

(u) The level shall be used in a level which shall be used

(v) The level shall be used in a level which shall be used

(w) The level shall be used in a level which shall be used

(x) The level shall be used in a level which shall be used

(y) The level shall be used in a level which shall be used

(z) The level shall be used in a level which shall be used

(aa) The level shall be used in a level which shall be used

(ab) The level shall be used in a level which shall be used

102. *Levers.*

- (a) Levers shall be numbered from left to right. 1916.
- (b) Levers shall be arranged so that they can be removed without interfering with other levers. 1911.
- (c) Spare levers, as specified under Section 100, shall be furnished in place complete, ready for the operation and control of their respective units. 1911.
- (d) Two-position levers shall be latched in both normal and reversed positions. Three-position levers shall be latched in the normal, central and reversed positions. 1914.
- (e) Levers shall be five (5) feet ten and one-eighth ( $10\frac{1}{8}$ ) inches from center of fulcrum to end of handle. 1911.
- (f) In machines of the same type all levers shall have equal and uniform throw and be so arranged that connections may be made to front or back of lever. 1911.
- (g) Tail levers for pipe connections shall be drilled to provide for eight and three-fourths ( $8\frac{3}{4}$ ), nine and three-fourths ( $9\frac{3}{4}$ ), and ten and three-fourths ( $10\frac{3}{4}$ ) inch stroke. 1916.
- (h) Provision  $\left\{ \begin{array}{l} \text{shall} \\ \text{shall not} \end{array} \right\}$  be made for adding a counterweight of .....(.) foot pounds torque on mechanical switch levers which will assist in moving lever to normal position. 1916.

LEADOUT AND GROUNDWORK

200. *Leadout.*

- (a) Leadout shall be  $\left\{ \begin{array}{l} \text{Rocking shaft.} \\ \text{Horizontal and vertical crank.} \\ \text{Deflecting bar.} \\ \text{Deflecting bar and vertical crank.} \end{array} \right\}$  1911.
- (b) Down rods shall be made of one and one-half ( $1\frac{1}{2}$ ) inch  $\left\{ \begin{array}{l} \text{steel} \\ \text{wrought iron} \end{array} \right\}$  pipe with standard one and one-fourth ( $1\frac{1}{4}$ ) inch jaws. 1914.

*Field work.*

- (c) Down rods shall be vertical with offset jaws, so that they may be connected to levers for either eight and three-fourths ( $8\frac{3}{4}$ ) inch or nine and three-fourths ( $9\frac{3}{4}$ ) inch stroke. 1916.
- (d) Leadout appliances shall be securely fastened to leadout supports with three-fourths ( $\frac{3}{4}$ ) inch bolts with bolt heads underneath. 1914.



(a) Lenses shall be measured from the right side.  
(b) Lenses shall be measured from the left side.  
(c) Lenses shall be measured from the front.  
(d) Lenses shall be measured from the back.  
(e) Lenses shall be measured from the top.  
(f) Lenses shall be measured from the bottom.  
(g) Lenses shall be measured from the side.  
(h) Lenses shall be measured from the center.  
(i) Lenses shall be measured from the edge.  
(j) Lenses shall be measured from the corner.

(k) Lenses shall be measured from the top and bottom.  
(l) Lenses shall be measured from the side and center.  
(m) Lenses shall be measured from the edge and corner.  
(n) Lenses shall be measured from the top and side.  
(o) Lenses shall be measured from the bottom and center.  
(p) Lenses shall be measured from the top and center.  
(q) Lenses shall be measured from the bottom and side.  
(r) Lenses shall be measured from the top and corner.  
(s) Lenses shall be measured from the bottom and center.  
(t) Lenses shall be measured from the top and side.

(u) Lenses shall be measured from the bottom and corner.  
(v) Lenses shall be measured from the top and center.  
(w) Lenses shall be measured from the bottom and side.  
(x) Lenses shall be measured from the top and corner.  
(y) Lenses shall be measured from the bottom and center.  
(z) Lenses shall be measured from the top and side.

(aa) Lenses shall be measured from the bottom and corner.  
(ab) Lenses shall be measured from the top and center.  
(ac) Lenses shall be measured from the bottom and side.  
(ad) Lenses shall be measured from the top and corner.  
(ae) Lenses shall be measured from the bottom and center.  
(af) Lenses shall be measured from the top and side.

(ag) Lenses shall be measured from the bottom and corner.  
(ah) Lenses shall be measured from the top and center.  
(ai) Lenses shall be measured from the bottom and side.  
(aj) Lenses shall be measured from the top and corner.  
(ak) Lenses shall be measured from the bottom and center.  
(al) Lenses shall be measured from the top and side.

(am) Lenses shall be measured from the bottom and corner.  
(an) Lenses shall be measured from the top and center.  
(ao) Lenses shall be measured from the bottom and side.  
(ap) Lenses shall be measured from the top and corner.  
(aq) Lenses shall be measured from the bottom and center.  
(ar) Lenses shall be measured from the top and side.

(as) Lenses shall be measured from the bottom and corner.  
(at) Lenses shall be measured from the top and center.  
(au) Lenses shall be measured from the bottom and side.  
(av) Lenses shall be measured from the top and corner.  
(aw) Lenses shall be measured from the bottom and center.  
(ax) Lenses shall be measured from the top and side.

(ay) Lenses shall be measured from the bottom and corner.  
(az) Lenses shall be measured from the top and center.  
(ba) Lenses shall be measured from the bottom and side.  
(bb) Lenses shall be measured from the top and corner.  
(bc) Lenses shall be measured from the bottom and center.  
(bd) Lenses shall be measured from the top and side.

(be) Lenses shall be measured from the bottom and corner.  
(bf) Lenses shall be measured from the top and center.  
(bg) Lenses shall be measured from the bottom and side.  
(bh) Lenses shall be measured from the top and corner.  
(bi) Lenses shall be measured from the bottom and center.  
(bj) Lenses shall be measured from the top and side.

202. Cranks.

*Material.*

(a) Vertical cranks shall be in accordance with R. S. A. drawings 1007, 1066 and 1067. 1916.

(b) Horizontal cranks shall be in accordance with R. S. A. drawings 1007, 1008 and 1393. 1916.

*Field work.*

(c) Cranks for main pipe lines shall be drilled eleven and three-fourths ( $11\frac{3}{4}$ ) by eleven and three-fourths ( $11\frac{3}{4}$ ) inch centers, and not more than one (1) crank shall be mounted on the same pin. 1916.

203. Deflecting bars.

*Material.*

(a) Vertical deflecting bars shall be in accordance with R. S. A. drawings 1068 and 1069. 1916.

(b) Horizontal deflecting bars shall be of the one-way multiple unit type and shall be in accordance with R. S. A. drawing 1069. 1916.

206. Rocking shafts and fittings.

*Material.*

(a) Rocking shafts and fittings shall be in accordance with R. S. A. drawings 1060, 1061 and 1063. 1916.

*Field work.*

(b) Rocking shafts shall be supported by a bearing at each end and not more than six (6) feet of shaft shall be unsupported. 1911.

(c) Rocking shaft bearings shall be securely bolted to foundations with four (4) three-fourths ( $\frac{3}{4}$ ) inch bolts. 1916.

210. Pipe and pipe lines.

*Material.*

(a) One (1) inch 

steel	}	pipe couplings,
wrought iron		

 plugs and rivets shall conform to R. S. A. specification, and drawing 1015. 1916.

(b) One (1) inch pipe shall be used for connections to switches, derails, movable wing and point frogs, detector bars, locks, bridge couplers and ..... signals. Where solid connections are required one and eleven thirty-seconds ( $1\frac{11}{32}$ ) inch round iron shall be used, unless otherwise specified. 1914.

Material.

- (a) Vertical cranks shall be in accordance with R. S. A. drawings 1066 and 1067.  
1916.  
(b) Horizontal cranks shall be in accordance with R. S. A. drawings 1068 and 1069.  
1916.

Field work.

- (c) Cranks for main pipe lines shall be drilled eleven and three-fourths (11 3/4) by eleven and three-fourths (11 3/4) inch centers, and not more than one (1) crack shall be mounted on the same pin.  
1916.

Material.

- (a) Vertical detecting bars shall be in accordance with R. S. A. drawings 1068 and 1069.  
1916.  
(b) Horizontal detecting bars shall be in accordance with R. S. A. drawings 1070 and 1071.  
1916.

ROCKING SHAFTS AND FITTINGS.

206. Rocking shafts and fittings.

Material.

- (a) Rocking shafts and fittings shall be in accordance with R. S. A. drawings 1060, 1061 and 1062.  
1916.

Field work.

- (b) Rocking shafts shall be supported by a bearing at each end and not more than six (6) feet of shaft shall be between the bearings.  
(c) Rocking shaft bearings shall be securely bolted to foundations with four (4) three-fourths (3/4) inch bolts.  
1916.

10. Pipe and pipe lines.

Material.

- (a) One (1) inch steel pipe couplings and fittings shall conform to R. S. A. specifications and drawings 1012.  
1916.  
(b) One (1) inch pipe shall be used for connections to switches, details, movable wing and point rods, and other parts, locks, bridge couplers and signals. Where solid connections are required one and one-half (1 1/2) inch pipe shall be used.  
1916.

210. *Pipe and pipe lines.*—Continued.

*Field work.*

(c) Pipe lines shall be in true alignment, with nearest pipe not less than four (4) feet six (6) inches from gauge line, except where authority to deviate is granted by the Purchaser. On drawbridges and approaches they shall be kept as far from gauge line as conditions will permit.

1916.

(d) Where practicable, pipes in main pipe line shall be run so that they will lead off on track side in regular order.

1911.

(e) Top of pipe carrier foundations in main pipe line shall be one-eighth ( $\frac{1}{8}$ ) inch below base of rail where conditions will permit.

1911.

(f) Cranks and compensators in main pipe run shall be so located as to leave field side clear for trunking and additional pipe lines.

1916.

(g) Pipe lines shall be laid two and three-fourths ( $2\frac{3}{4}$ ) inch centers and shall be supported on pipe carriers placed not more than eight (8) feet centers on tangents, and on curves of two (2) degrees or more they shall be spaced not more than seven (7) feet centers.

1916.

(h) With the lever in the center position of stroke, the couplings in pipe line shall be located not less than twelve (12) inches from pipe carriers.

1916.

(i) Where so specified "I" beam track supports shall be used where pipe lines cross under tracks, and construction shall be in accordance with ..... drawing ..... dated ....., and shall be furnished in place by the Purchaser.

1911.

(j) Pipe lines running under tracks shall be arranged to permit standard spacing and proper tamping of ties, except where otherwise provided.

1911.

(k) Turns in pipe lines shall be made with deflecting bars, radial arms or cranks as follows:

Angle of Deflection. Degrees	Bars	Radius
0 to 11	..... with tang ends.	.....
11 to $33\frac{1}{2}$	$22\frac{1}{2}$ deg. with eye ends.	72 inch.
$33\frac{1}{2}$ to 56	45 deg. with eye ends.	36 inch.
56 to $78\frac{1}{2}$	$67\frac{1}{2}$ deg. with eye ends.	24 inch.
$78\frac{1}{2}$ to 90	90 deg. with eye ends.	18 inch.





210. *Pipe and pipe lines.* (k)—Continued.

Degrees	Radial Arms and Cranks	
0 to 30	15 deg. radial arm cranks.	
30 to 75	60 deg. acute angle cranks.	
75 to 105	90 deg. right angle cranks.	
105 to 140	120 deg. obtuse angle cranks.	
140 to 180	180 deg. equalizing arms.	1911.

(l) Deflecting bars shall not be used at any point where the total movement of the pipe line, due to stroke expansion and contraction, is more than eleven (11) inches.

1916.

(m) Offsets in pipe lines shall be made in body of jaws, or an iron rod one and eleven thirty-seconds ( $1\frac{11}{32}$ ) inch in diameter. The total offset between any two supports shall never exceed three and one-half ( $3\frac{1}{2}$ ) inches; minimum distance between ends of offset shall be not less than twice the amount of the offset. Offsets in cranks and compensators shall be avoided as far as practicable.

1914.

212. *Stuffing boxes.*

*Material.*

(a) Stuffing boxes for one (1) inch pipe shall be in accordance with R. S. A. drawing 1225.

1916.

*Field work.*

(b) Where necessary to run pipe lines underground, they shall be encased in two (2) inch galvanized iron pipe filled with non-freezing oil and provided at each end with a stuffing box.

1916.

213. *Pipe carriers.*

*Material.*

(a) Pipe carriers shall be in accordance with R. S. A. drawings 1071, 1072, 1073, 1084 and 1085.

1916.

*Field work.*

(b) Pipes leading under track rails shall be supported by transverse pipe carriers.

1916.

(c) Pipe carriers for main pipe runs shall be fastened to iron foundations with two (2) one-half ( $\frac{1}{2}$ ) inch bolts and to wood foundations with two (2) one-half by two and one-half ( $\frac{1}{2} \times 2\frac{1}{2}$ ) inch lag screws.

1916.

(d) Transverse pipe carrier bearers shall be fastened to foundations with two (2) three-fourths by four ( $\frac{3}{4} \times 4$ ) inch lag screws.

1916.

(e) Strap pipe carriers shall be fastened to foundations with two (2) one-half by two and one-half ( $\frac{1}{2} \times 2\frac{1}{2}$ ) inch lag screws.

1911.

210. Pipe and pipe lines. (b) - (Continued).

Pressure	Minimum Allowable Cover
1 to 10	18 deg. below zero & above
10 to 25	20 deg. below zero & above
25 to 100	30 deg. below zero & above
100 to 140	120 deg. above zero & below
140 to 180	180 deg. equalizing stress

(1) The following parts shall be made in one piece, and the total movement of the pipe line, due to the expansion and contraction, shall be allowed for in the design.

(2) Offsets in pipe lines shall be made in body of pipe, or on main run and eleven thirty-seconds (11.3%) inches in diameter. The total offset between any two offsets shall be not less than twice the amount of the offset. The minimum distance between ends of offsets shall be not less than twice the amount of the offset. The total offset shall be not less than twice the amount of the offset. The minimum distance between ends of offsets shall be not less than twice the amount of the offset.

211. THE LAYING

(a) Stringing poles for one (1) inch pipe shall be in accordance with R. S. A. 210.1.

(b) Where necessary, the main pipe lines shall be supported by towers. The towers shall be spaced at intervals of not more than 100 feet. The towers shall be constructed of wood or steel, and shall be capable of supporting the weight of the pipe and the weight of the water in the pipe. The towers shall be constructed of wood or steel, and shall be capable of supporting the weight of the pipe and the weight of the water in the pipe.

Pipe carriers.

(A) Pipe carriers shall be in accordance with R. S. A. 210.1.

(B) The main pipe line shall be supported by towers. The towers shall be spaced at intervals of not more than 100 feet. The towers shall be constructed of wood or steel, and shall be capable of supporting the weight of the pipe and the weight of the water in the pipe.

(C) The main pipe line shall be supported by towers. The towers shall be spaced at intervals of not more than 100 feet. The towers shall be constructed of wood or steel, and shall be capable of supporting the weight of the pipe and the weight of the water in the pipe.

(D) The main pipe line shall be supported by towers. The towers shall be spaced at intervals of not more than 100 feet. The towers shall be constructed of wood or steel, and shall be capable of supporting the weight of the pipe and the weight of the water in the pipe.

(E) The main pipe line shall be supported by towers. The towers shall be spaced at intervals of not more than 100 feet. The towers shall be constructed of wood or steel, and shall be capable of supporting the weight of the pipe and the weight of the water in the pipe.

(F) The main pipe line shall be supported by towers. The towers shall be spaced at intervals of not more than 100 feet. The towers shall be constructed of wood or steel, and shall be capable of supporting the weight of the pipe and the weight of the water in the pipe.

(G) The main pipe line shall be supported by towers. The towers shall be spaced at intervals of not more than 100 feet. The towers shall be constructed of wood or steel, and shall be capable of supporting the weight of the pipe and the weight of the water in the pipe.

(H) The main pipe line shall be supported by towers. The towers shall be spaced at intervals of not more than 100 feet. The towers shall be constructed of wood or steel, and shall be capable of supporting the weight of the pipe and the weight of the water in the pipe.

220. *Compensators.*

*Material.*

(a) Compensators shall be in accordance with R. S. A. drawings 1013, 1014 and 1231. 1916.

(b) Not more than one (1) horizontal, or more than two (2) vertical compensators shall be mounted on one (1) stand. 1911.

*Field work.*

(c) In territory where the temperature variation is less than one hundred and twenty (120) degrees, compensation shall be provided for each pipe line as follows:

1. Lengths forty (40) feet to seven hundred (700) feet, connected to switches, movable point frogs and point derails with ten by thirteen (10x13) inch arms. 1916.

2. Lengths eighty (80) feet to seven hundred (700) feet connected to facing point locks, switch and lock movements, lift derails, signals, etc., with ten by thirteen (10x13) inch arms. 1916.

3. Lengths seven hundred (700) feet to eleven hundred (1100) feet with ten by sixteen (10x16) inch arms. 1916.

4. Lengths over eleven hundred (1100) feet with additional compensators. 1916.

5. Not more than six hundred and twenty-five (625) feet of pipe shall be compensated by an eleven and three-fourths (11¾) inch crank. 1916.

(d) In territory where temperature variation is more than one hundred and twenty (120) degrees, compensation shall be provided for each pipe line as follows:

1. Lengths forty (40) feet to five hundred (500) feet connected to switches, movable point frogs and point derails with ten by thirteen (10x13) inch arms. 1916.

2. Lengths seventy (70) feet to five hundred (500) feet connected to facing point locks, switch and lock movements, lift derails, signals, etc., with ten by thirteen (10x13) inch arms. 1916.

3. Lengths five hundred (500) feet to eight hundred (800) feet with ten by sixteen (10x16) inch arms. 1916.

4. Lengths over eight hundred (800) feet with additional compensators. 1916.

5. Not more than four hundred and thirty (430) feet of pipe shall be compensated by an eleven and three-fourths (11¾) inch crank. 1916.

6. One (1) screw jaw shall be placed in the pipe line on the tower side of each compensator. 1916.

Compressors

Material

- (a) Compressors shall be in accordance with B. S. A. drawings 1017, 1018 and 1019.  
(b) Not more than one (1) horizontal or more than two (2) vertical compressors shall be mounted on one (1) stand.

(c) In territory where the temperature variation is less than one hundred and twenty (120) degrees, compression shall be provided for each pipe line as follows:

1. Lengths forty (40) feet to seven hundred (700) feet connected to switches, movable point locks and point details with ten by thirteen (10x13) inch arms.

2. Lengths eighty (80) feet to seven hundred (700) feet connected to locking point locks, switch and lock movements, with details, with ten by thirteen (10x13) inch arms.

3. Lengths over seven hundred (700) feet to eleven hundred (1100) feet connected to switches, movable point locks and lock movements, with details, with ten by thirteen (10x13) inch arms.

4. Lengths over eleven hundred (1100) feet with additional compressors.

5. Not more than six hundred and twenty-five (625) feet of pipe shall be compensated by an eleven and three-fourths (11 3/4) inch arm.

(d) In territory where temperature variation is more than one hundred and twenty (120) degrees, compression shall be provided for each pipe line as follows:

1. Lengths forty (40) feet to five hundred (500) feet connected to switches, movable point locks and point details with ten by thirteen (10x13) inch arms.

2. Lengths seventy (70) feet to five hundred (500) feet connected to locking point locks, switch and lock movements, with details, with ten by thirteen (10x13) inch arms.

3. Lengths five hundred (500) feet to eight hundred (800) feet with ten by thirteen (10x13) inch arms.

4. Lengths over eight hundred (800) feet with additional compressors.

5. Not more than four hundred and thirty (430) feet of pipe shall be compensated by an eleven and three-fourths (11 3/4) inch arm.

6. One (1) screw jaw shall be placed in the pipe line on the tower side of each compressor.



220. *Compensators.—Continued.*

- (e) Compensation shall be provided in pipe lines in accordance with R. S. A. drawing 1102. 1916.

230. *Jaws and lugs.*

*Material.*

- (a) Jaws and lugs shall be in accordance with R. S. A. drawings 1016, 1017, 1018 and 1019. 1916.

*Field work.*

- (b) Solid jaws shall be used for connections to all cranks, compensators, deflecting bars, couplers, rail locks, pipe connected levers and balance levers, unless otherwise specified. 1911.

- (c) Screw jaws shall be placed in pipe line as follows: One (1) for each switch and lock movement, detector bar connection, bolt lock connection, each end of bolt lock bar, signal and .....; they shall be located as close as practicable to the unit to be adjusted. 1916.

235. *Pipe adjustments.*

*Material.*

- (a) Pipe adjusting screws shall be in accordance with R. S. A. drawing 1002. 1916.

*Field work.*

- (b) Pipe adjusting screws shall be placed in each pipe line as follows:

1. One (1) for each facing point lock. 1914.
2. One (1) for each switch and lock movement. 1914.
3. One (1) for high signal. 1914.
4. One (1) for dwarf signal. 1914.
5. One (1) for bridge lock and couplers. 1914.
6. Two (2) for each through connection made by bridge couplers. 1914.

- (c) Pipe adjusting screws shall be located as near as practicable to the unit to be adjusted without being directly under the track rails, guard rails, frogs, switches or bridge guards. 1914.

- (d) Switches, derails, movable wing frogs and movable point frogs, shall be provided with switch adjustments fastened to the head rods. 1911.

260. *Pins.*

*Material.*

- Jaw, crank and compensator pins shall be in accordance with R. S. A. drawing 1010. 1916.



Material  
Jaw, crane and compensator pins shall be in accordance with R. S. A. drawing 1001.

(d) Switches, details, movable wing frogs and movable point frogs shall be provided with switch adjustments fastened to the base rods.  
(e) Pipe adjusting screws shall be located as near as practicable to the nut to be adjusted without being directly under the track rails, guard rails, frogs, switches or bridge girders.  
1014.

6. Two (2) for each through connection made by bridge couplers.  
1014.  
5. One (1) for bridge lock and couplers.  
1014.  
4. One (1) for dwarf signal.  
1014.  
3. One (1) for high signal.  
1014.  
2. One (1) for each switch and lock movement.  
1014.  
1. One (1) for each facing point lock.  
1014.  
line as follows:

(b) Pipe adjusting screws shall be placed in each pipe field work.

(a) Pipe adjusting screws shall be in accordance with R. S. A. drawing 1001.

One (1) for each switch and lock movement between but (c) 2 jaw pins shall be placed in pipe line as follows:  
wise specified.  
1014.

(b) Solid jaws shall be used for connections to all cranks, compensators, deflecting bars, couplers, rail locks, pipe connected levers and balance levers, unless otherwise specified.

Field work.  
(a) Jaws and lugs shall be in accordance with R. S. A. drawings 1001, 1017, 1018 and 1019.  
Material.

30. Jaws and lugs.

(e) Compensation shall be provided in pipe lines in accordance with R. S. A. drawing 1001.  
Compensation—Continued.

261. Bolts, screws and washers.

*Material.*

(a) Bolts, tap bolts, set screws, and machine screws shall have United States standard threads, nuts and heads.

1914.

(b) Nuts, bolt heads, tap bolt heads, etc., used in connection with the machine shall be hexagonal, all others shall be square.

1911.

(c) Lag screws shall be standard with gimlet points and square heads.

1911.

(d) Washers shall be standard flat cut.

1911.

*Field work.*

(e) Lag screws shall be inserted their entire length into holes previously filled with oil. These holes shall be bored small enough to provide full thread.

1911.

(f) Flat washers shall be used under bolt heads, nuts and heads of lag screws where they come in contact with wood.

1911.

FOUNDATIONS

270. Foundations.\*

*Material.*

(a) Pipe carrier foundations shall consist of:

1. Iron piers with ..... tops and bottoms.

1911.

2. Concrete piers with ..... tops and bottoms.

1911.

3. ....

1911.

(b) Iron pipe carrier foundation piers shall be in accordance with R. S. A. drawing 1109.

1916.

(c) Concrete pipe carrier foundation piers shall be in accordance with R. S. A. drawing 1080.

1916.

*Field work.*

(d) Foundations shall be rigid, level, and in good alignment.

1916.

(e) Foundations shall be set parallel to track, except as otherwise specified.

1911.

(f) Concrete foundations shall be in accordance with R. S. A. drawings 1103, 1104, 1105, 1106, 1107, 1108 and 1259.

1916.

\*The dimensions for concrete foundations indicated are for level and solid ground. The Purchaser and Contractor shall jointly decide when deviations from specified sizes are necessary.

1916.



270. *Foundations.—Continued.*

(g) Concrete foundations shall stand until properly set before any apparatus is connected thereto or placed thereon.

1911.

(h) One (1) concrete pier shall be used for each pipe carrier foundation up to twenty-five and three-fourths ( $25\frac{3}{4}$ ) inches long, and one (1) additional pier for each additional thirty-four (34) inches or fraction thereof.

1911.

(i) Two (2) piers shall be used for each iron pier pipe carrier foundation up to forty-five (45) inches long and one (1) additional pier shall be provided for each additional thirty-six (36) inches or fraction thereof and intermediate piers shall be inverted.

1911.

280. *Concrete.*

Concrete shall conform to R. S. A. specification.

1916.

290. *Boxing.*

Where boxing is specified, it shall be made of two (2) by eight (8) inch ..... lumber, dressed one (1) side. Where bottom in boxing is specified, it shall be made of one (1) inch ..... rough lumber; through highways the sides shall be made of three by six (3x6) inch and three by ten (3x10) inch ..... lumber and shall be spiked to the foundation tops. Four by twelve (4x12) inch ..... lumber shall be used for tops and it shall be cut diagonally and not nailed to sides.

1911.

SWITCHES

300. *Switch mechanism.*

*Material.*

(a) Switch mechanisms shall perform their normal operations in the following sequence:

1. Unlock switch.

2. Throw switch.

3. Lock switch.

1911.

(b) Switch and lock movement shall be provided with staggered locking for normal and reverse position of points.

1911.

(c) Parts of mechanism shall be strong enough to permit of stopping the switch at any point of its movement by the introduction of an obstruction between the point and stock rail, without injury to any part.

1911.

(d) Switch and lock movements shall be securely bolted to five-eighths by twelve inch by four feet ten inch ( $5\frac{7}{8}$ "x 12"x4' 10") steel plate.

1914.





300. *Switch mechanism.—Continued.*

*Field work.*

(e) The location of switch operating mechanism shall be as shown on ..... drawing ..... 1911.

(f) Switch and lock movements shall be placed on outside track not nearer than thirty (30) inches from gauge line of nearest rail to center of movement and shall be bolted to ties and tie plate with six (6) three-fourths ( $\frac{3}{4}$ ) inch bolts. 1914.

301. *Mechanical connections.*

(a) Arrangement and support of connections shall be such that switch points can be stopped by placing an obstruction between point and stock rail at any part of stroke, without breaking or bending any connections; also shall be strong enough to prevent bending or breaking in case mechanism is operated when detector bar is engaged by wheels of a car or engine. 1911.

(b) Both the operating and the lock rod shall be of sufficient strength to alone and independently hold the switch points in position. 1911.

310. *Facing point locks.*

*Material.*

(a) Facing point lock stands and plungers shall be in accordance with R. S. A. drawing 1096. 1916.

*Field work.*

(b) Facing point locks shall be used on all switches, derails, movable wing frogs and movable point frogs, except where otherwise specified on drawings. 1911.

(c) Where facing point locks are used they shall be arranged to lock switches in normal and reversed position and derails in ..... position. 1916.

(d) Facing point lock stands shall be placed outside of track as shown on drawing ..... dated ..... 1916.

(e) Facing point lock plungers shall have full stroke of pipe line and stand one (1) inch clear of lock bar when switch is unlocked. 1911.

312. *Lock rods.*

*Material.*

(a) Lock rod shall be in accordance with R. S. A. drawing 1237. 1916.

How big?

312. *Lock rods.—Continued.*

*Field work.*

(b) Holes or notches in lock rods and the ends of plungers or locking dogs, shall have square edges, and the holes or notches shall be not more than one-sixteenth ( $\frac{1}{16}$ ) inch larger than the plunger or locking dog, measured in a horizontal line. 1916.

(c) Lock rods shall run direct from front rods or switch lugs into lock stands. 1914.

313. *Bolt locks.\**

*Material.*

(a) Bolt locks shall be in accordance with R. S. A. drawing 1095. 1916.

*Field work.*

(b) Lock rod shall be connected to point lug in accordance with R. S. A. drawing 1223 (detail 122318). 1916.

(c) When switches are located between interlocking station and signal, the signal bar of bolt lock shall form a part of the pipe line operating the signal; when switches are not located between interlocking station and signal, the signal bar of bolt lock shall form a part of the pipe line operating the signal. 1916.

(d) When electric locking or switch circuit controllers are not used, facing point switches, movable wing frogs and movable point frogs in high speed routes shall be bolt-locked with signals governing such routes, and all facing derails shall be bolt-locked with all signals governing over them. 1916.

320. *Gauge, butt and riser plates.*

*Material.*

(a) Gauge plates shall be  
    { one-half by six ( $\frac{1}{2} \times 6$ ) }  
    { three-fourths by six ( $\frac{3}{4} \times 6$ ) } } inch merchant bar steel  
or of following composition:

---

\*Where local conditions are such that it is not practicable to install bolt-locking, it is recommended that circuit controllers be placed on facing switches, derails, movable wing frogs and movable point frogs, and that their respective operating levers be provided with electric locks on lock levers to insure that switches have responded to the position of the lever, or where semi-automatic signals are used, they shall be controlled by circuit controllers on switches, derails, movable wing frogs and movable point frogs. 1916.

Book ends - Continued.

Field work

(b) Holes or notches in book ends and the ends of  
plungers or locking bolts shall be made of hardened steel and the  
notches or notches shall be made of hardened steel and the  
(100) inch diameter shall be made of hardened steel and the  
notches in a hardened steel.  
(c) Lock ends shall be direct from the ends of  
switch ends into lock ends.

W. 100-100000

(d) The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.

(e) The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.  
The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.  
The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.

(f) When the ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.  
The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.  
The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.

W. 100-100000

W. 100-100000

(g) The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.  
The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.  
The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.

(h) The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.  
The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.  
The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.  
The ends of the book ends shall be made of hardened steel and the  
notches in a hardened steel.

320. Gauge, butt and riser plates. (a)—Continued.

Carbon	.35 to .45	
Manganese	.40 to .60	
Sulphur (not to exceed)	.04	
Phosphorus (not to exceed)	.04	1916.

(b) Butt plates shall be merchant bar steel, one by three by six (1x3x6) inch; drilled for three (3) three-fourths ( $\frac{3}{4}$ ) inch rivets; middle rivet staggered. 1916.

(c) Riser plates shall be wrought iron three-eighths by six by ten ( $\frac{3}{8}$ x6x10) inches, drilled for two (2) three-fourths ( $\frac{3}{4}$ ) inch rivets, four (4) inches between centers, and eight and one-half ( $8\frac{1}{2}$ ) inches from the rail end of the plate, and one (1) three-fourths ( $\frac{3}{4}$ ) inch rivet one and one-half ( $1\frac{1}{2}$ ) inch from the rail end of the plate.

1911.

*Field work.*

(d) Not less than three (3) gauge plates shall be used for all switches and split point derails and shall be located so that one (1) plate shall be placed on point tie, and one (1) on nearest tie on each side and extended under plate supporting facing point lock and base plate for switch and lock movement. 1916.

(e) Not less than four (4) gauge plates shall be used for each set of movable point frogs and shall be located so that one (1) plate will be placed on point tie and one (1) on first tie back of point tie for each pair of points.

1916.

(f) Gauge plates shall be fitted in place and securely fastened to the ties with ..... (..) three-fourths by four ( $\frac{3}{4}$ x4) inch lag screws or screw spikes. 1916.

322. Rail braces.

*Material.*

(a) Rail braces shall be  $\left\{ \begin{array}{l} \text{solid} \\ \text{adjustable} \end{array} \right\}$  of the ..... type. 1916.

*Field work.*

(b) Rail braces shall be used on gauge plate on point tie and on gauge plates each side of point tie for all switches and split point derails. For each set of movable point frogs, braces shall be used on gauge plate on point tie and on gauge plate on first tie back of point tie for each pair of points. 1916.





330. *Tie straps.*

*Material.*

- (a) Tie straps shall be one-half by two ( $\frac{1}{2} \times 2$ ) inch merchant bar steel. 1916.

*Field work.*

- (b) Tie straps shall be used at all switches, derails, movable wing frogs and movable point frogs, to tie all crank, rocking shaft, point and intermediate ties together, placed on top of ties and fastened to each tie with one (1) three-fourths by four ( $\frac{3}{4} \times 4$ ) inch lag screw or ..... track spikes. 1916.

340. *Detector bars.*

*Material.*

- (a) Detector bars and driving pieces shall be in accordance with R. S. A. drawing 1098. 1915.  
(b) Rail clips shall be in accordance with R. S. A. drawing 1099. 1915.

*Field work.*

- (c) Bars shall be located as shown on ..... drawing ....., unless otherwise specified. 1911.

- (d) Detector bars shall be arranged to give ..... (..) feet continuous protection for all switches, derails, movable wing frogs, and movable point frogs. 1911.

- (e) Detector bars when practicable shall be so connected that the unlocking movement when switch is in the main line position shall be in reverse direction to the facing movement of traffic over the points. 1915.

- (f) Fifty-three (53) feet bars shall be mounted on sixteen (16) rail clips and a proportionate number of clips shall be used for longer or shorter bars. 1911.

- (g) Center of rail clips shall be placed eight (8) inches and twenty-six (26) inches respectively from end and the remaining clips approximately three (3) feet nine (9) inches apart. 1911.

- (h) Bars shall rise a minimum of three-fourths ( $\frac{3}{4}$ ) inch above top of rail at every point during the locking and unlocking of the switch, and shall rest one-fourth ( $\frac{1}{4}$ ) inch below top of rail at every point when lever travel is completed. 1911.

- (i) Where radial arm clips are used combination bar stops and guides shall be provided, one (1) for every ten (10) feet of bar (equally spaced) and not less than two (2) such stops on one (1) bar. 1911.

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1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

340. *Detector bars.—Continued.*

(j) Driving pieces shall be placed midway between two (2) clips in space not occupied by joint in bar, and the driving rod shall have a length of not more than seven (7) feet unsupported. 1915.

348. *Section locking circuits.*

Section locking circuits { will } be required in  
   { will not }  
 { addition to } detector bars. 1914.  
 { lieu of }

SIGNALS

400. *Type.* (a) Signals shall be of the semaphore type with arm travel ..... (..) degrees in the .....

{ right } quadrant. 1916.  
 { left }

(b) The type of signals (as shown by the R. S. A. symbols) and location of signals shall be in accordance with ..... drawing ..... 1916.

*Material.*

(c) Signals and fittings shall be in accordance with the following R. S. A. drawings:

- 1026. Ladders.
- 1027. Ladder parts.
- 1029. Ladder clamps and stays.
- 1032. Channel column bracket posts.
- 1033. Mounting for bottom mast mechanism case on bracket post.
- 1034. Base for ground signal mast.
- 1035. Signal masts.
- 1036. Base for bridge and bracket mast.
- 1038. Base for pipe bracket posts.
- 1039. Pipe bracket post.
- 1040. Semaphore spectacle, design "A."
- 1041. Semaphore spectacle, design "B."
- 1043. One-arm mechanical ground signal.
- 1044. Two-arm mechanical ground signal.
- 1045. Three-arm mechanical ground signal.
- 1049. Lamp brackets.
- 1050. Pinnacle.
- 1052. Ladder Foundations.
- 1059. Clamps for base of ground signal mast.
- \*1065. Blades for upper quadrant signals.

\*High blades shall be made of { enameled steel. }  
   { well seasoned ..... }

Enameled steel blades shall be in accordance with .....  
 ..... drawing ..... 1916.

Detector base - mounting.

(1) The detector base shall be spaced suitably above the ground in order to avoid contact with the ground and shall have a length of not less than 100 mm.

Section (a) of the detector base shall be of the following dimensions:

width	100 mm
height	100 mm

The detector base shall be of the same material as the detector and shall be of the same shape and size as the detector.

(2) The detector base shall be of the same material as the detector and shall be of the same shape and size as the detector.

(c) Signals and bearings - signals shall be of the following R. S. A. dimensions:

- |      |                              |
|------|------------------------------|
| 1001 | Channel, standard, 100 mm    |
| 1002 | Mounting for channel, 100 mm |
| 1003 | Base for channel, 100 mm     |
| 1004 | Base for channel, 100 mm     |
| 1005 | Base for channel, 100 mm     |
| 1006 | Base for channel, 100 mm     |
| 1007 | Base for channel, 100 mm     |
| 1008 | Base for channel, 100 mm     |
| 1009 | Base for channel, 100 mm     |
| 1010 | Base for channel, 100 mm     |
| 1011 | Base for channel, 100 mm     |
| 1012 | Base for channel, 100 mm     |
| 1013 | Base for channel, 100 mm     |
| 1014 | Base for channel, 100 mm     |
| 1015 | Base for channel, 100 mm     |
| 1016 | Base for channel, 100 mm     |
| 1017 | Base for channel, 100 mm     |
| 1018 | Base for channel, 100 mm     |
| 1019 | Base for channel, 100 mm     |
| 1020 | Base for channel, 100 mm     |
| 1021 | Base for channel, 100 mm     |
| 1022 | Base for channel, 100 mm     |
| 1023 | Base for channel, 100 mm     |
| 1024 | Base for channel, 100 mm     |
| 1025 | Base for channel, 100 mm     |
| 1026 | Base for channel, 100 mm     |
| 1027 | Base for channel, 100 mm     |
| 1028 | Base for channel, 100 mm     |
| 1029 | Base for channel, 100 mm     |
| 1030 | Base for channel, 100 mm     |
| 1031 | Base for channel, 100 mm     |
| 1032 | Base for channel, 100 mm     |
| 1033 | Base for channel, 100 mm     |
| 1034 | Base for channel, 100 mm     |
| 1035 | Base for channel, 100 mm     |
| 1036 | Base for channel, 100 mm     |
| 1037 | Base for channel, 100 mm     |
| 1038 | Base for channel, 100 mm     |
| 1039 | Base for channel, 100 mm     |
| 1040 | Base for channel, 100 mm     |
| 1041 | Base for channel, 100 mm     |
| 1042 | Base for channel, 100 mm     |
| 1043 | Base for channel, 100 mm     |
| 1044 | Base for channel, 100 mm     |
| 1045 | Base for channel, 100 mm     |
| 1046 | Base for channel, 100 mm     |
| 1047 | Base for channel, 100 mm     |
| 1048 | Base for channel, 100 mm     |
| 1049 | Base for channel, 100 mm     |
| 1050 | Base for channel, 100 mm     |
| 1051 | Base for channel, 100 mm     |
| 1052 | Base for channel, 100 mm     |
| 1053 | Base for channel, 100 mm     |
| 1054 | Base for channel, 100 mm     |
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| 1058 | Base for channel, 100 mm     |
| 1059 | Base for channel, 100 mm     |
| 1060 | Base for channel, 100 mm     |
| 1061 | Base for channel, 100 mm     |
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| 1076 | Base for channel, 100 mm     |
| 1077 | Base for channel, 100 mm     |
| 1078 | Base for channel, 100 mm     |
| 1079 | Base for channel, 100 mm     |
| 1080 | Base for channel, 100 mm     |
| 1081 | Base for channel, 100 mm     |
| 1082 | Base for channel, 100 mm     |
| 1083 | Base for channel, 100 mm     |
| 1084 | Base for channel, 100 mm     |
| 1085 | Base for channel, 100 mm     |
| 1086 | Base for channel, 100 mm     |
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| 1092 | Base for channel, 100 mm     |
| 1093 | Base for channel, 100 mm     |
| 1094 | Base for channel, 100 mm     |
| 1095 | Base for channel, 100 mm     |
| 1096 | Base for channel, 100 mm     |
| 1097 | Base for channel, 100 mm     |
| 1098 | Base for channel, 100 mm     |
| 1099 | Base for channel, 100 mm     |
| 1100 | Base for channel, 100 mm     |

High frequency shall be made of well annealed steel and shall be in accordance with the following dimensions:



400. *Type.* (c)—Continued.

- 1070. Binding post.
- 1082. Mechanical semaphore bearing and shaft (also 1194).
- 1083. Mechanical semaphore bearing and shaft (also 1194).
- 1090. Filler blocks to limit travel of signal arms.
- 1091. Filler blocks to limit travel of signal arms.
- 1092. Filler blocks to prevent travel of signal arms.
- 1093. Diagram of spectacle clearance.
- 1097. Mechanical dwarf signal.
- 1178. Base clamp for bracket and bridge signal mast.
- 1179. Hand rail for bracket mast.
- 1190. Mechanical connections for 6-way bracket post.
- 1191. Mechanical connections for 3-arm bridge and bracket mast.
- 1194. Mechanical semaphore bearing and shaft (also 1082 or 1083).
- 1196. Guides for vertical one (1) inch pipe leads for bracket mast.
- 1198. Adjustable arm cranks and supports for bracket mast.
- 1199. Adjustable arm cranks and supports for bracket mast.
- 1232. Mechanical dwarf signal top and base bearings.
- \*\*1233. Mechanical dwarf signal spectacles and lamp bracket support.
- 1235. Semaphore spectacle, design "C."
- 1239. Mechanical dwarf signal fittings.

*Field work.*

(d) Signal masts shall be on the right of the track governed and adjacent thereto, where practicable.

1911.

(e) Signal arms on tangent shall be at right angles to track governed when sufficient approach is on tangent. On curves signal arms shall be at right angles to imaginary line drawn from the signal to the point where the best view can be obtained by the engineman, as decided by the Purchaser.

1911.

(f) Before any signals are erected, the Purchaser shall, in the presence of the Contractor's foreman (or other representative) locate each signal.

1911.

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\*\*Three-position  $\left\{ \begin{array}{l} \text{upper} \\ \text{lower} \end{array} \right\}$  quadrant dwarf spectacle shall be in accordance with ..... drawing 1916.  
.....

1081 Mechanical semaphore position and shift (1081)

to limit travel of signal lever  
to limit travel of semaphore  
sticks to prevent travel in signal arm

1082 Part of up for switch and bridge signal arm

1083 Mechanical connections for 6-way two-hand post

1084 Mechanical connections for 6-way two-hand post

1085 Mechanical connections for 6-way two-hand post

1086 Mechanical connections for 6-way two-hand post

1087 Adjustable arm signal and signal arm post

1088 Mechanical device signal arm and post

1089 Mechanical device signal arm and post

1090 Mechanical device signal arm and post

1091 Mechanical device signal arm and post

1092 Mechanical device signal arm and post

1093 Mechanical device signal arm and post

1094 Mechanical device signal arm and post

1095 Mechanical device signal arm and post

1096 Mechanical device signal arm and post

1097 Mechanical device signal arm and post

1098 Mechanical device signal arm and post

1099 Mechanical device signal arm and post

1100 Mechanical device signal arm and post

1101 Mechanical device signal arm and post

1102 Mechanical device signal arm and post

400. *Type.*—Continued.

(g) Outside of tracks, dwarf signals shall be placed  
 ..... (..) feet, ground masts ..... (..) feet and bracket posts ..... (..) feet from  
 nearest rail. 1911.

(h) Bridge masts shall be located on .....  
 chord of bridge. 1911.

(i) Base of dwarf signals shall be ..... (..) inches below base of rail. Base of high signals shall be level with base of rail unless otherwise specified. 1916.

425. *Roundels.*

Roundels shall conform to R. S. A. specification and shall be furnished as follows:

	Color.	Diameter Inches.
Stop .....	.....	..... (..)
Caution .....	.....	..... (..)
Proceed .....	.....	..... (..)
Back light .....	.....	..... (..)

430. *Lamps.*

(a) Lamps shall be { oil  
                                 electric }  
                                 convertible } 1915.

(b) Oil lamps shall be in accordance with R. S. A. drawings 1100 and 1101. 1915.

(c) Convertible lamps shall be equipped with .....  
 ..... (..) incandescent lamps in accordance with .....  
 ..... drawing, dated ..... and with long time  
 oil founts and burners. 1916.

(d) ..... (..) extra incandescent lamps shall be furnished. 1911.

(e) Incandescent lamps shall conform to ..... specifications. 1915.

PAINTING

800. *Paint.*

*Material.*

(a) Purchaser will indicate here the kind of paint that shall be required:  
 .....  
 .....  
 .....

*Field work.*

(b) Surfaces covered with rust, grease, dirt or other foreign substances, shall be thoroughly cleaned before paint or oil is applied. 1911.

(c) Paint shall not be applied to outside surfaces in freezing weather, nor to wet surfaces, nor until previous coating has thoroughly dried. 1911.



800. *Paint.*—Continued.

(d) Finishing coats shall not be applied until after the expiration of forty-eight (48) hours after the previous coating has been applied. 1911.

(e) Paints mixed on the ground shall be applied within three (3) hours after the pigment and oil are mixed. 1911.

(f) Priming coat shall be applied as soon as consistent with the progress of the work. 1911.

(g) Second coat shall be applied in sufficient time for the third coat to be applied and dry when the installation is completed. 1911.

(h) Iron work (except interlocking machine, tie plates, iron foundation piers), not galvanized, shall be painted one (1) coat of red lead and raw linseed oil and two (2) finishing coats. Galvanized iron pipe shall be painted at threads, pipe rivets and wherever galvanizing is damaged. 1916.

(i) The following specific finishing coats shall be used:

	Kind of Paint	Color
Signal bridges and brackets	.....	.....
Signal masts	.....	.....
Dwarf signals	.....	.....
All connections	.....	.....

1911.

(j) Outside iron connections, switch and signal fittings, not machine finished, shall be dipped in raw linseed oil before shipment from works. 1911.

(k) Machine, except locking, levers and other finished parts, shall be painted one coat of red lead and raw linseed oil and one finishing coat of black. 1914.

(l) Unfinished part of levers and latches shall be painted one coat of red lead and raw linseed oil and two coats of Purchaser's standard color, as follows:

	Color
Home signal levers	.....
Distant signal levers	.....
Lock levers	.....
Other working levers	.....
Spare levers	.....
Hand releases	.....

1914.

(m) Exposed wood work shall be given one (1) priming coat and finishing coats as follows:



(2) If the work is not completed after the expiration of the period (48) hours from the date

(3) If the work is not completed after the expiration of the period (48) hours from the date

(4) If the work is not completed after the expiration of the period (48) hours from the date

(5) If the work is not completed after the expiration of the period (48) hours from the date

(6) If the work is not completed after the expiration of the period (48) hours from the date

(7) If the work is not completed after the expiration of the period (48) hours from the date

(8) If the work is not completed after the expiration of the period (48) hours from the date

(9) If the work is not completed after the expiration of the period (48) hours from the date

(10) If the work is not completed after the expiration of the period (48) hours from the date

(11) If the work is not completed after the expiration of the period (48) hours from the date

(12) If the work is not completed after the expiration of the period (48) hours from the date

800. *Paint.* (m)—Continued.

	Kind of Paint	Color	Number of Coats
Home signal blades	.....	.....	.....
Dwarf signal blades	.....	.....	.....
Distant signal blades	.....	.....	.....
Trunking junction boxes, etc.	.....	.....	.....
Foundation tops and bottoms	.....	.....	.....

1911.

(n) Interlocking station and other buildings, if constructed of wood, shall receive one (1) priming coat and two (2) finishing coats. The priming coat shall consist of ..... and, when thoroughly dry, two (2) coats of ....., in the following tints, shall be applied:

1911.

SPECIAL ITEMS

900.

.....  
.....  
.....

1911.

925. *Locks.*

Purchaser's standard locks shall be furnished by the ..... and shall be used where specified. 1915.

926. *Number plates and numbers.*

(a) Number plates: .....

.....  
.....

1911.

(b) Numbers: .....

.....  
.....  
.....

1911.



**OIL.***Illuminating, Specification.**Transformer, Specification.***PETROLEUM.**—*For use in Impedance Bonds.***PETROLEUM ASPHALTUM.**—*Specification.***PINS.**—*See Channel Pins, or Crossarms—Steel Pins.***PINE.**—*Signal.**Soft Steel, One-Inch, Specification.**Wrought Iron, One-Inch, Specification.***POLES, EASTERN WHITE CEDAR.**—*Specification.***PUSH BUTTONS.**—*Specification.* **PUSHES, FLOOR.**—*Specification.***REACTORS FOR LINE AND TRACK CIRCUITS.**—*Specification.***RELAYS, A.C.**—*Specification.***RELAYS, LIFTING ARMATURE NEUTRAL TYPE, D.C.**—*Specification.***RELEASES, MECHANICAL AND ELECTRIC.**—*Specification.***ROUNDELS, LENSES AND SLIDES.**—*Specification.***RULES.***Governing Maintenance of Block Signals.**Governing Signal Foremen.**Governing Signal Maintainers.**Governing Signal Supervisors.***SIGNALS, D.C. MOTOR SEMAPHORE.**—*Specification.***SIGNALING PRACTICE.***Signal Indications and Aspects. (Am. Ry. Eng. Ass'n.)***STEEL, MACHINERY.**—*Specification.***SWITCHBOARDS.***Slate, for Battery Charging, Specification.**Slate and Equipment for A.C. Signal System, Specification.*

PETROLEUM.--For use in Impedance Bonds.

Wrought Iron, One Inch, Specification.  
Soft Steel, One Inch, Specification.



## SPECIFICATION FOR ALTERNATING CURRENT RELAY.

1916.

1. *Requisite sheet.*

A requisite sheet (similar to Section 11 of this specification) shall accompany the Purchaser's request for quotations. The Purchaser's requirements not contained in other paragraphs of this specification may be given on this sheet, or it may be submitted to the Manufacturers for them to specify, thereon, the operating characteristics and other data, of the relays, which they propose to furnish. The requisite sheet shall form a part of this specification.

1916.

2. *Design.*

(a) The relay shall be of a design approved by the Purchaser.

1912.

(b) Moving parts, with the exception of the pneumatically operated portion of the electropneumatic relays, shall be enclosed in a weatherproof, dustproof case, ventilated or non-ventilated, as specified.

1916.

(c) The enclosure for the contact parts shall be so designed that the contacts may be readily seen, by inspection, from the outside.

1916.

(d) All metal parts liable to corrosion, except wearing and contact surfaces, shall be protected from corrosion. Material used for protection shall not soften or flake off between temperatures thirty-five (35) degrees C., below zero, and sixty-five (65) degrees C., above zero.

1916.

3. *Binding posts.*

Binding posts shall conform to R. S. A. specification.

1916.

4. *Flexible connections.*

The flexible connections from binding posts to contact fingers shall be of sufficient section to carry without injury, the current which the contact fingers are designed to carry and break.

1916.

5. *Contacts.*

(a) Contacts in normal operation shall make a wiping contact and shall exert a pressure of not less than 0.5 ounce.

1916.

(b) Resistance of cleaned contacts shall not exceed 0.5 ohms.

1916.

# REQUIREMENTS FOR ALTERNATING CURRENT RELAY

A requisite sheet (similar to Section 11 of this specification) shall be submitted by the Manufacturer. The Purchaser's requirements not contained in other paragraphs of this specification may be given on this sheet or it may be submitted to the Manufacturer for them to specify, wherein, the operating characteristics and other data of the relay, which they propose to furnish. The requisite sheet shall form a part of this specification.

## 2. Design.

- (a) The relay shall be of a design approved by the Purchaser.
- (b) Moving parts, with the exception of the parts which are operated in a waterproof, dustproof case, shall be enclosed in a weatherproof, dustproof case, vented to the atmosphere.
- (c) The contacts shall be made of a material designed that the contacts may be readily inspected.
- (d) All metal parts liable to corrosion, except wiring and contact surfaces, shall be protected from corrosion by a suitable material which shall not soften or flake off.
- (e) The relay shall be capable of operating at temperatures between temperatures thirty-five (35) degrees C. below zero, and sixty-five (65) degrees C. above zero.

Binding posts shall conform to R. S. A. specification.

The flexible connection from binding posts to contact fingers shall be of sufficient section to carry without injury, the current which the contact fingers are designed to carry and break.

- (a) Contacts in normal operation shall make a wiping contact and shall exert a pressure of not less than 0.5 ounce.
- (b) Resistance of cleaned contacts shall not exceed 0.5

5. *Contacts.*—Continued.

(c) Contacts shall be so adjusted that in their open position there shall be at least 0.031 inch space between the fixed post and the contacting point. 1916.

(d) All parts of the contact fingers (other than the contact point), including its conducting ribbon and the post to which the ribbon is attached, shall be separated by at least 0.1 inch from any other metal or conducting parts of the relay. 1916.

6. *Insulation.*

(a) A leakage distance of not less than three-eighths ( $\frac{3}{8}$ ) inch shall be provided between any part of the relay carrying current and any other metal part located outside of the enclosed portion of the relay. This insulation shall withstand a test of 3000 volts a.c. for one minute. 1916.

(b) Separate windings which are insulated from each other and from other metal or conducting parts of the relay shall withstand a test of 3000 volts a.c. for one minute. This voltage shall be applied between terminals of the separate windings and between terminals and other metal or conducting parts from which the terminals and windings are insulated. 1916.

(c) Varnished paper or any similar material that will be affected by moisture or change in the temperature between thirty-five (35) degrees, C., below zero, and sixty-five (65) degrees, C., above zero, shall not be used as an insulator for binding posts or contact fingers. 1916.

7. *Clearance.*

Under the most unfavorable conditions of play and relative position of parts in the assembled relay, all moving parts except bearings and contacts shall be separated by not less than the following guaranteed minimum clearances:

Radial 0.020 inch.

Longitudinal 0.017 inch.

The guaranteed minimum end play of the moving element shall be 0.010 inch. 1916.

8. *Operation.*

(a) The contacts closed with the relay energized shall open from the fully energized position, by gradual reduction in voltage, at forty-five (45) per cent. of the voltage required to just close the contacts; in case of two-element relays this test shall be made by reducing

Contacts.—Continued.

- (c) Contacts shall be so adjusted that in their open position there shall be at least one inch space between the fixed post and the contacting point.
- (5) All parts of the contact shall be stronger than the contact point, including its contacting tip and the post to which the spring is attached shall be separated by at least one inch from any other metal or conducting parts of the relay.

Insulation.

- (a) A leakage distance of not less than three-eighths (3/8) inch shall be provided between any part of the relay carrying current and any other metal part mounted on the side of the relay, the insulation shall withstand a test of 500 volts a.c. for one minute.
- (b) Separate windings which are housed in one case other and from other metal or conducting parts of the relay shall withstand a test of 500 volts a.c. for one minute. This voltage shall be applied to terminals of the separate windings and between terminals and the case.
- (c) Varnished paper or any other insulating material that will be affected by moisture or change in the temperature between thirty-five (35) degrees C. below zero and one hundred (100) degrees C. above zero shall not be used as insulation for binding posts or contact fingers.

Adjustment.

Under the most unfavorable conditions of play and relative position of parts in the assembled relay, the moving parts except bearings and contacts shall be separated by not less than the following distances in inches:

Between contact point and fixed post, .010 inch.

Between contact point and part of the moving element shall be .010 inch.

Tests.

- (a) The test is passed when the relay energized shall open from the fully energized position by gradual reduction in voltage at forty-five (45) per cent of the voltage required to just close the contacts; in case a two-element relay this test shall be made by reducing



8. *Operation.* (a)—Continued.

the voltage on the controlled element only, the voltage on the local element being maintained at constant rated value. 1916.

(b) The voltage required to make contact shall not be less than fifty (50) per cent. of the voltage required to bring the contacts to their rated pressure. In case of two-element relays this test shall be made by varying the voltage on the controlled element only. 1916.

(c) The relay shall perform satisfactorily when the voltage on all elements is reduced to eighty-five (85) per cent. of their rated voltages. 1916.

(d) For two-element track relays the above readings shall be made with ideal phase relations between the currents in the two windings. 1916.

(e) For two-element line relays the above readings shall be made with phase relations between the two windings which approximate conditions as specified on the requisite sheet. 1916.

9. *Sealing.*

The enclosure containing the moving parts of the relay shall be sealed with the Manufacturer's seal. 1916.

10. *Operating data.*

(a) Each relay shall bear a metal name plate on which is stated:

Rated volts and amperes at terminals of each element.	1916.
Frequency.	1916.

(b) The following additional data shall be stated on either the metal name plate or a paster:

Manufacturer's name.	1916.
Type.	1916.
Serial number.	1916.
Type of external device.	1916.
Volts, including external device.	1916.

(c) Both metal name plate and paster shall be so located that they can be readily seen when the relay is in its operating position. 1916.



the voltage on the controlled element only; the voltage on the local element being maintained at constant rated

(b) The voltage required to make contact shall not be less than fifty (50) per cent of the voltage required to bring the contacts to their rated pressure. In case of two-element relays this test shall be made by varying the voltage on the controlled element only.

(c) The relay shall perform satisfactorily when the voltage on all elements is reduced to eighty-five (85) per cent of their rated voltage.

(d) For two-element relays the above readings shall be made with short phase relations between the currents in the two windings.

(e) For two-element line relays the above readings shall be made with phase relations between the two windings which approximate conditions as specified on the

The enclosure containing the moving parts of the relay shall be sealed with the Manufacturer's seal.

#### Operating data.

(a) Each relay shall have a metal name plate on which is stenciled:

Rated volts and amperes at terminals of each element.  
Frequency.

(b) The following additional data shall be stenciled on either the metal name plate or a poster:

Manufacturer's name.  
Type.  
Serial number.  
Type of external device.

(c) Both metal name plate and poster shall be so fastened that they can be readily seen when the relay is in

## II REQUISITES - CONTINUED -

CHARACTERISTICS - CONTINUED -		COLUMN N°1.	COLUMN N°2.
CONNECTION OF CONTROLLED ELEMENT TO LINE.	DIRECT		
	SERIES DEVICE		
TWO PHASE.			
THREE PHASE			
TWO POSITION.			
THREE POSITION BY REVERSE OPERATION.			
THREE POSITION BY CONSECUTIVE OPERATION.			
POWER	a- RATED INPUT AT RELAY TERMINALS.		
	CONTROL ELEMENT	VOLTS	
		AMPERES	
		V.A.	
		WATTS	
		P.F.	
	LOCAL ELEMENT	VOLTS	
		AMPERES	
		V.A.	
		WATTS.	
		P.F.	
	THIRD ELEMENT.	VOLTS	
		AMPERES	
		V.A.	
		WATTS.	
		P.F.	
	b- INPUT TO RELAY CIRCUITS INCLUDING EXTERNAL DEVICES.		
	CONTROL CIRCUIT	VOLTS	
		AMPERES	
		V.A.	
		WATTS.	
		P.F.	
	LOCAL CIRCUIT.	VOLTS	
		AMPERES	
		V.A.	
		WATTS.	
		P.F.	
	THIRD CIRCUIT.	VOLTS	
		AMPERES	
		V.A.	
		WATTS.	
		P.F.	



5  
Railway Signal Association.

Relay, A.C.  
Requisites.

II REQUISITES

		NUMBER OF EACH TYPE OF RELAY REQUIRED.	
		COLUMN N°1	COLUMN N°2
W D Y T	a-NON-SELECTIVE WITH RESPECT TO FREQUENCY.		
	VANE		
	IRON GALVANOMETER.		
	IRONLESS GALVANOMETER.		
	INDUCTION MOTOR		
	SHELL ROTOR. IRON ROTOR.		
	Z- ARMATURE		
	TRACTIVE MAGNET.		
	ELECTRO-PNEUMATIC *		
	b-SELECTIVE WITH RESPECT TO FREQUENCY.		
	VANE FREQUENCY.		
	CENTRIFUGAL FREQUENCY.		
*FOR SPECIFICATIONS COVERING THE PNEUMATIC FEATURES OF THIS RELAY SEE R.S.A SPECIFICATIONS FOR ELECTRO- PNEUMATIC INTERLOCKING.			
CHARACTERISTICS.			
MANUFACTURER'S NAME.			
CATALOGUE REFERENCE.			
TRACK			
LINE.			
TIME REQUIRED TO OPEN CONTACT AFTER DE-ENERGIZATION OF RELAY.		CONTACT N°1	
		" " 2	
		" " 3	
		" " 4	
TIME REQUIRED TO CLOSE CONTACT AFTER DE-ENERGIZATION OF RELAY		CONTACT N°1	
		" " 2	
		" " 3	
		" " 4	
TIME REQUIRED TO OPEN CONTACT AFTER ENERGIZATION OF RELAY		CONTACT N°1	
		" " 2	
		" " 3	
		" " 4	
TIME REQUIRED TO CLOSE CONTACT AFTER ENERGIZATION OF RELAY.		CONTACT N°1	
		" " 2	
		" " 3	
		" " 4	
SINGLE ELEMENT			
DOUBLE ELEMENT			
DOUBLE ELEMENT: SPLIT PHASE.			
DOUBLE ELEMENT: SERIES CONNECTION.			

CENTRIFUGAL FREQUENCY		TO FREQUENCY		RELATIVE WITH 100%		GALVANOMETER		NUMBER OF EACH TYPE	
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100



6  
*Railway Signal Association.*

Relay, A.C.  
 Requisites.

II REQUISITES-CONTINUED:

CHARACTERISTICS-CONTINUED -		COLUMN N°1	COLUMN N°2
RATED FREQUENCY.			
SHALL NOT MAKE CONTACT ON D.C.			
SHALL NOT MAKE CONTACT ON A.C.			
OF A FREQUENCY BELOW:-		CYCLES	CYCLES
TRACK RELAY TO BE UNAFFECTED BY THE FOLLOWING VALUES OF PROPULSION CURRENT.	SURGE	AMPS FOR SECS.	AMPS. FOR SECS.
	CONTINUOUS	AMPS.	AMPS.
CONTACTS.	INDEPENDENT	FRONT.	
		BACK	
		DE-ENERGIZED.	
	NON INDEPENDENT.	FRONT & BACK.	
		FRONT & DE-ENERGIZED.	
		BACK & DE-ENERGIZED.	
CARRYING CAPACITY.		AMPS	AMPS
TO OPEN CIRCUIT OF		AMPS D.C. AT VOLTS A.C.	AMPS D.C. AT VOLTS A.C.
INCLOSURE FOR CONTACTS	VENTILATED		
	NON-VENTILATED		
SPECIAL REQUISITES.			
REMARKS.			
NOTE:- IN FILLING OUT THE THREE SHEETS OF THIS FORM USE THE WORD "YES" EXCEPT WHERE DEFINITE VALUES OR QUANTITIES ARE CALLED FOR. DRAW A LINE THROUGH SPACE NOT OTHERWISE FILLED OUT			



## TAPE.

*Friction, Specification.**Rubber Insulating, Specification.*

## TERMINOLOGY, ELECTRIC WIRE AND CABLE.

## TRAIN CONTROL, AUTOMATIC.

## TRANSFORMERS.

*Single-phase Line, Oil Immersed, Self-cooled, Out-door Type,  
4400 Volts or less, Specification.**Single-phase Track, 250 Volts or less, Specification.*TRUNKING AND CAPPING, GROOVED.—*Specification.*

## VOLTAGE RANGES FOR SIGNAL WORK.

## WIRE.

*Bonding, Copper-Clad Steel, Specification.**Bonding, Galvanized E. B. B., Specification.**Line, Copper-Clad Steel, Specification.**Line, W. P. D. B., B. B., Specification.**Line, W. P. D. B., Copper, Specification.**Magnet, Copper Enameled, Specification.**Messenger, Galvanized, Specification.**Messenger, Recommended Sags for.**Rubber Insulated, Copper, Specification.**Rubber Insulated, Insulation Resistances.**Rubber Insulated, Inspection Report, Form for.**Rubber Insulated, Machine for Insulating, Type of.**Steel, Signal Galvanized, Specification.**Stranded and Flexible Conductors, Table of.*

## WIRE CROSSINGS.

*Crossings of Wires or Cables of Telegraph, Telephone, Signal  
and other Circuits of Similar Character over Steam Railroad  
Rights of Way, Track or Lines of Wires of the same classes,  
Specifications. (Ass'n. of Ry. Teleg. Supts.)*



SPECIFICATION FOR FRICTION TAPE.

1914.

Revised 1916.

1. *General.*

(a) The intent of this specification is to provide for the furnishing of cotton insulating friction tape. 1916.

(b) The tape shall be made of cotton sheeting which is thoroughly impregnated on both sides with a friction rubber compound. The edges of the tape shall be straight and the width even. No pinholes should be observable when the tape is held before a strong light. 1914.

2. *Friction rubber compound.*

(a) The compound shall have a rubber base and be of the strength and insulating qualities required to meet the specified physical and electrical tests. 1914.

(b) The compound shall be free from active sulphur or other substances which will act injuriously on copper or the cotton tape. 1914.

3. *Cotton tape.*

The cotton tape shall be cut from a sheeting well, evenly and firmly woven from good cotton and free from defects, dirt, knots, lumps and objectionable irregularities of twist. The warp of the fabric shall extend lengthwise of the tape and the tape shall not ravel continuously when unwound from the original roll. 1914.

4. *Tests.*

(a) The Manufacturer shall provide, at his factory, apparatus and other facilities needed for making the required physical and electrical tests. 1914.

(b) Tests shall be made from samples taken from any part of any roll and may also be made upon the finished product immediately after being delivered. If the requirements of this specification are not met the tape will be rejected and the Manufacturer shall pay freight charges for return of such material. 1916.

5. *Physical tests.*

The adhesion between the piles of the finished tape when unwound from the original roll and wound upon a one-quarter ( $\frac{1}{4}$ ) inch mandrel under a tension of seven and one-half ( $7\frac{1}{2}$ ) pounds, shall be such that a weight of one and one-half ( $1\frac{1}{2}$ ) pounds shall not separate the piles at a greater rate than eight (8) inches per minute. 1914.



# SPECIFICATION FOR FRICTION TAPE

Revised 1914

(a) The intent of this specification is to provide for the uniformity of cotton insulating friction tape. 1914

(b) The tape shall be made of cotton shearing which is thoroughly impregnated on both sides with a friction rubber compound. The edges of the tape shall be straight and the width even. No pinholes should be observable when the tape is held before a strong light. 1914

(c) The strength and insulation qualities required to meet the specified physical and electrical tests. 1914

(d) The tape shall be made of cotton shearing which will not injuriously on paper or the cotton tape. 1914

## Cotton tape

The cotton tape shall be cut from a shearing well evenly and fairly woven from good cotton and free from twist. The warp of the fabric shall extend lengthwise of the tape and the weft shall not ravel continuously when unwound from the original roll. 1914

(e) The Manufacturer shall provide at his factory apparatus and other facilities needed for making the required physical and electrical tests. 1914

(f) Tests shall be made from samples taken from any part of any roll and may also be made upon the finished product immediately after being delivered. If the requirements of this specification are not met the tape will be rejected and the Manufacturer shall pay freight charges for return of such material. 1914

## Physical tests

The adhesion between the sides of the finished tape when unwound from the original roll and wound upon a one-quarter (1/4) inch mandrel under a tension of seven and one-half (7 1/2) pounds shall be such that a weight of one and one-half (1 1/2) pounds shall not separate the sides at a greater rate than eight (8) inches per minute. 1914

6. *Tensile strength.*

The tensile strength of the tape shall be not less than thirty (30) pounds per three-quarters ( $\frac{3}{4}$ ) inch width.

1914.

7. *Heat test.*

Strips of the tape after being exposed to a dry heat of two hundred and ten (210) degrees Fahr. for sixteen (16) hours shall, immediately on removal from the heat, be wound for a length of two (2) feet upon a one-quarter ( $\frac{1}{4}$ ) inch mandrel under a tension of seven and one-half ( $7\frac{1}{2}$ ) pounds at the rate of two (2) feet in one (1) minute, and when unwound therefrom under a tension of one and one-half ( $1\frac{1}{2}$ ) pounds, the rate of separation shall not exceed one and one-half ( $1\frac{1}{2}$ ) inches per minute for the twelve (12) inches in the middle of the test piece.

1916.

8. *Electrical test.*

The dielectric strength of the tape shall be such as to withstand for five (5) minutes a test current of one thousand (1000) volts at sixty (60) cycles, applied by placing a section of the tape between two (2) brass ball electrodes, each three-quarters ( $\frac{3}{4}$ ) inch in diameter and so spaced the tape will just move between.

1914.

9. *Packing for shipment.*

(a) The tape shall be furnished in strips having the following dimensions and weight:

Width	$\frac{3}{4}$ inch.
Thickness (approximate)	0.015 inch.
Minimum length per pound	90 feet.
Weight per roll	$\frac{1}{2}$ pound. 1916.

(b) Each roll shall be enclosed in a tin box or wrapped in tinfoil and enclosed in a box to secure and fully protect the contents.

1914.

(c) Each package shall contain the full specified weight of tape, exclusive of wrapping and boxes, and shall be marked with the Manufacturer's name, the width of the tape and its weight.

1914.

strength.

The tensile strength of the tape shall be not less than thirty (30) pounds per three-quarters (¾) inch width.

1914

Strips of the tape after being exposed to a dry heat of two hundred and ten (210) degrees Fahrenheit for sixteen (16) hours shall, immediately on removal from the heat, be wound for a length of two (2) feet upon a one-quarter (¼) inch mandrel under a tension of seven and one-half (7½) pounds at the rate of two (2) feet in one (1) minute, and when removed from the mandrel under a tension of one and one-half (1½) pounds, the rate of separation shall not exceed one and one-half (1½) inches per minute for the twelve (12) inches in the middle of the test piece.

Stand for five (5) minutes at the rate of one thousand (1000) volts at sixty (60) cycles, applied at a frequency of the tape between the two plates shall be spaced, each three-quarters (¾) inch apart, and so spaced the tape will just move between.

1914

for shipment

(a) The tape shall be furnished in rolls having the following dimensions and weight:

Width	¾ inch
Thickness (approximate)	0.001 inch
Minimum length per pound	50 feet
Weight per roll	25 pounds 1916

(b) Each roll shall be enclosed in a tin box or wrapped in tinfoil and enclosed in a box to secure and fully protect the contents.

1914

(c) Each package shall contain the full specified weight of tape, exclusive of wrapping and boxes, and shall be marked with the Manufacturer's name, the width of the tape and its weight.

1914

## SPECIFICATION FOR RUBBER INSULATING TAPE.

1914.

Revised 1916.

### 1. General.

(a) The intent of this specification is to provide for the furnishing of rubber insulating tape. 1916.

(b) The tape shall be unvulcanized, shall have a smooth surface and be entirely free from holes. The edges shall be straight, the width even, and when being unwound from the original roll the insulation shall show no tendency to stick to the separator. 1914.

### 2. Material.

(a) The tape shall be made exclusively from pure up-river, fine Para rubber of best quality, solid waxy hydrocarbons, suitable mineral matter and sulphur, properly and thoroughly mixed. Before being mixed with the other ingredients the rubber shall be thoroughly washed and dried. 1914.

(b) Each of the dry mineral matter ingredients shall be thoroughly dried and passed through a sieve having not less than one hundred (100) meshes to the inch for the whiting and sixty (60) meshes to the inch for the other ingredients before they are mixed. 1914.

(c) The ingredients used in the mixture shall be of a quality here specified and within the proportional limits by weight given in the following table:

Ingredient	Percentage by weight	
	Minimum	Maximum
Up-river, fine Para rubber	30.5	32.
Whiting	....	30.
Zinc oxide	28.	As desired.
Litharge	1.	6.
Sulphur	1.5	2.5
Ozokerite or parrafin	2.	3.
	Chemical Composition	Lowest grade acceptable
Whiting	CaCo <sub>3</sub>	96% pure
Zinc oxide	ZnO	Red seal

1914.

(d) Barytes may be used as a substitute for a part of the whiting and the sulphur so introduced will not be included in the allowable sulphur content. 1914.

(e) The manufacturing processes shall be perfected to prevent, as far as practicable, excessive working of the rubber. 1914.

# RECOMMENDATIONS FOR THE USE OF RUBBER INSULATING TAPE

1914

General

- (a) The intent of this specification is to provide for the following of rubber insulating tape.
- (b) The tape shall be manufactured shall have a smooth surface and be entirely free from holes. The edges shall be straight the width even and when being unwound from the original roll the insulation shall show no tendency to stick to the separator.

1914

- (a) This tape shall be made exclusively from pure river, fine grain rubber of best quality, solid wax, hydrocarbon antiolefin mineral matter and sulphur, proprietary and homogeneously mixed. Before being mixed with the other ingredients the mixture shall be thoroughly washed and dried.
- (b) Each of the dry mineral ingredients shall be less than one hundred (100) meshes to the inch for the whitening and sixty (60) meshes to the inch for the other ingredients before they are mixed.
- (c) The ingredients used in the mixture shall be of a

1914

Ingredient	Maximum	Minimum
Whitening	28	As desired
Zinc oxide	1	6
Litharge	1	3
Antimony	1	3
Oxide of lead	1	3
Whitening	CaCO <sub>3</sub>	Red seal
Zinc oxide	ZnO	Red seal

- (d) Various may be used as a substitute for a part of the whitening and the sulphur so introduced will not be included in the allowable sulphur content.
- (e) The manufacturing processes shall be perfected to prevent, as far as practical, excessive working of the rubber.

1914



3. *Tests.*

(a) The Manufacturer shall provide, at his factory, apparatus and other facilities needed for making the required physical and electrical tests. 1914.

(b) Tests shall be made from samples taken from any part of any roll and may also be made upon the finished product immediately after being delivered. If the requirements of these specifications are not met the tape will be rejected and the Manufacturer shall pay freight charges for return of such material. 1914.

4. *Tensile strength.*

The tensile strength of the tape shall be not less than two hundred and fifty (250) nor more than five hundred (500) pounds to the square inch. 1914.

5. *Specific gravity.*

The specific gravity of the insulation shall be not less than 1.85. 1914.

6. *Heat test.*

The tape, when wrapped to a thickness of one-quarter ( $\frac{1}{4}$ ) inch and heated to one hundred and fifty (150) degrees Fahr. for twenty (20) minutes shall fuse into a homogeneous mass. 1914.

7. *Chemical tests.*

The insulation shall show on analysis not less than thirty (30) nor more than thirty-three (33) per cent. of pure up-river, fine Para rubber of best quality; not more than three (3) per cent. of waxy hydrocarbons, consisting of refined parrafin of pure ozokerite; not more than two and five-tenths (2.5) per cent. total sulphur, exclusive of the sulphur of barytes; no salts of barium other than barytes; freedom from all foreign matter, and the mineral matter shall be such as will not have a deleterious effect on the insulation. 1914.

8. *Electrical tests.*

The dielectric strength of the tape shall be such as to withstand for five (5) minutes, without breaking down, a test current of two hundred and fifty (250) volts at sixty (60) cycles, per mill of thickness, applied by placing a section of the tape between two (2) brass ball electrodes, each three-quarters ( $\frac{3}{4}$ ) inch in diameter and so spaced that the unstretched tape will just move between. 1914.

- (a) The Manufacturer shall provide, at his factory, apparatus and other facilities needed for making the required physical and electrical tests.
- (b) Tests shall be made from samples taken from any part of any roll and may also be made upon the finished product immediately after being delivered. If the requirements of these specifications are not met the tape will be rejected and the Manufacturer shall pay freight charges for return of such material.

#### A. Tensile strength.

The tensile strength of the tape shall be not less than two hundred and fifty (250) nor more than five hundred (500) pounds to the square inch.

The specific gravity of the insulation shall be not less than 1.85.

The tape, when wound on a roll, shall be not less than 24 inches wide and not more than 36 inches wide. It shall be marked with the number of the roll and the number of the layer.

The insulation shall show on analysis not less than thirty (30) nor more than thirty-three (33) per cent of pure unadmixed fine barium sulphate of best quality, not more than three (3) per cent of waxy hydrocarbons, consisting of refined paraffin of pure oxo-ketone; not more than two and five-tenths (2.5) per cent total sulphur, exclusive of the sulphur of barium; no salts of barium other than barium; freedom from all foreign matter, and the mineral matter shall be such as will not have a deleterious effect on the insulation.

The dielectric strength of the tape shall be such as to withstand for five (5) minutes, without breaking down, a test current of two hundred and fifty (250) volts at sixty (60) cycles, per mill of thickness, applied by placing a section of the tape between two (2) brass ball electrodes, each three-quarters (3/4) inch in diameter and so spaced that the unattached tape will just move between.

## ELECTRIC WIRE AND CABLE TERMINOLOGY.

1916.

*Wire.* A slender rod or filament of drawn metal.

*Conductor.* A wire or combination of wires not insulated from one another, suitable for carrying a single electric current.

*Stranded conductor.* A conductor composed of a group of wires or any combination of groups of wires.

*Cable.* (1) A stranded conductor (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).

*Strand.* One of the wires or groups of wires of any stranded conductor.

*Stranded wire.* A group of small wires, used as a single wire.

*Cord.* A small cable, very flexible and substantially insulated to withstand wear.

*Concentric strand.* A strand composed of a central core surrounded by one or more layers of helically laid wires or groups of wires.

*Concentric-lay cable.* A single-conductor cable composed of a central core surrounded by one or more layers of helically laid wires.

*Rope-lay cable.* A single-conductor cable composed of a central core surrounded by one or more layers of helically laid groups of wires.

*N-conductor cable.* A combination of N conductors insulated from one another.

*N-conductor concentric cable.* A cable composed of an insulated central conducting core with (N-1) tubular stranded conductors laid over it concentrically and separated by layers of insulation.

*Duplex cable.* Two insulated single-conductor cables twisted together.

*Twin cable.* Two insulated single-conductor cables laid parallel, having a common covering.

# ELECTRIC WIRE AND CABLE TERMINOLOGY

1016

Wire. A slender rod or filament of a soft metal.

Conductor. A wire or combination of wires not insulated from one another, suitable for carrying a single electric current.

Stranded conductor. A conductor composed of a group of wires or any combination of groups of wires.

Cable. (1) A stranded conductor (single-conductor cable); or (2) a combination of conductors insulated from one another.

Strand. One of the wires or groups of wires of any stranded conductor.

Stranded wire. A group of small wires, used as a single wire.

Cord. A small cable, very flexible and substantially insulated to withstand wear.

Concentric strand. A strand composed of a central core surrounded by one or more layers of helically laid wires or groups of

Concentric-lay cable. A single-conductor cable composed of a central core surrounded by one or more layers of helically laid wires

Rope-lay cable. A single-conductor cable composed of a central core surrounded by one or more layers of helically laid groups of

N-conductor cable. A combination of N conductors insulated from one another.

Over it concentrically and separated by layers of insulation.

Duplex cable. Two insulated single-conductor cables twisted to-

Twin cable. Two insulated single-conductor cables laid parallel.

*Triplex cable.* Three insulated single-conductor cables twisted together.

*Twisted pair.* Two small insulated conductors twisted together, without a common covering.

*Twin wire.* Two small insulated conductors laid parallel, having a common covering.

In order to illustrate the proper use of the terms, the following discussion is submitted as information:

"The use of a cable in the transmission of a single current is in general restricted to the cases where the current is large. This requires a large conductor, which for practical reasons is standard. It may be either a single group or solid wires, or it may have a more complex structure. A seven-strand cable may be a single conductor made up of seven solid wires, or a single conductor made up of seven groups of wires, or a combination of seven conductors insulated from one another. In the latter case, each of the seven strands may be either solid or itself stranded. When one of the strands of a conductor is composed of more than one wire, each element of the strand is also called a strand. Stranded conductors are very commonly formed of concentric strands, which consist of a central core surrounded by one or more layers of helically laid wires. If used as a completed cable, such a conductor is called a concentric lay cable. Such a group may be combined with others in the same way in which the wires are combined in the group, thus forming a concentric strand composed of elements, each of which is a concentric strand. If a concentric strand so formed is used as a complete cable, it is known as a rope-lay cable."



Triple cable. Three insulated single-conductor cables twisted together.

Twisted pair. Two small insulated conductors twisted together without a common covering.

Twin wire. Two small insulated conductors laid parallel having

In order to illustrate the proper use of the terms, the following discussion is submitted as information:

"The use of a cable in the transmission of a single current is in general restricted to the cases where the current is large. This restriction is a large conductor, which for practical reasons is standard. It may be either a single group of solid wires, or it may have a more complex structure. A seven-strand cable may be a single conductor made up of seven solid wires, or a single conductor made up of seven insulated conductors. It is also possible to have a cable made up of several insulated conductors. A cable is composed of one or more strands. Stranded conductors are very common. It is also called a strand. Stranded conductors which consist of a central core surrounded by concentric strands, which consist of a central core surrounded by one or more layers of helically laid wires. It is used as a complete cable. Such a group may be combined with others in the same way in which the wires are combined in the group, thus forming a concentric strand composed of elements, each of which is a concentric strand. If a concentric strand so formed is used as a complete cable, it is known as a rope-lay cable."

SPECIFICATION FOR SINGLE-PHASE LINE TRANSFORM-  
ERS, OIL IMMERSED, SELF-COOLED, OUT-DOOR  
TYPE, 4400 VOLTS OR LESS.  
1916.

1. *Requisite sheet.*

A requisite sheet (similar to section seventeen (17) of this specification) shall accompany the Purchaser's request for quotations. The Purchaser's requirements not contained in other sections may be given on this sheet, or it may be submitted to the Manufacturers for them to specify thereon the operating characteristics and other data of the transformers they propose to furnish. The requisite sheet shall form a part of this specification.

1916.

2. *Type.*

Transformers may be of the core or shell type. They shall be oil-immersed, self-cooled and designed for outdoor service.

1912.

3. *Frequency.*

Transformers shall be designed for operation on circuits of frequency specified in section 17.

1916.

4. *Rating.*

Transformers shall have a continuous K. V. A. rating equal to the sum of the ratings of all the secondaries, as specified in section 17.

1916.

5. *Windings.*

The voltages, power capacities, and power factor of the load on the separate windings shall be as specified in section 17.

1916.

6. *Cases.*

(a) Transformer case shall be made of cast iron, provided with a cast iron cover. Eyebolts or lugs shall be provided for handling the transformer and lugs for supporting it. Case shall be free from leaks and shall be impervious to oil. Covers shall be provided with felt or other suitable gaskets. Plugs shall be provided at bottom of case for removing fluids. Case shall be provided with a suitable terminal for grounding same.

1916.

(b) Each case shall bear a metal name plate on which is stated Manufacturer's name, type, serial number, K. V. A. capacity, frequency, phase, and voltages of each winding for which transformer is designed.

1916.

SECTION FOR THE SINGLE PHASE TRANSFORMER  
IS ON THE LINE, SINGLE PHASE TRANSFORMER  
THESE ARE THE

1. The transformer shall be of the oil immersed type, with a capacity of 100 KVA, and shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts. The transformer shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts. The transformer shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts.

Transformers shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts. The transformer shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts.

TRANSFORMER

Transformers shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts. The transformer shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts.

Transformers shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts. The transformer shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts.

WIRING

The wiring shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts. The transformer shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts.

(a) The wiring shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts. The transformer shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts.

(b) The wiring shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts. The transformer shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts.

(c) The wiring shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts. The transformer shall be of the standard design, with a primary voltage of 11,000 volts and a secondary voltage of 240 volts.

6. *Cases.—Continued.*

(c) A voltage diagram shall be pasted inside the cover of each transformer. 1916.

(d) Transformer shall be fastened into the case so as to absolutely prevent the core and coils from shifting and yet permit them to be readily and quickly removed.

1916.

7. *Hangers.*

Hanger irons and bolts of sufficient strength to mount complete transformer in an upright position on pole, shall be furnished with each transformer. 1916.

8. *Leads and connection boards.*

(a) Leads out of case shall be of insulated flexible wire of a cross section not less than Number Twelve (12) American Wire Gauge. 1916.

(b) The left-hand lead from each secondary shall be of the same instantaneous polarity as the left-hand lead to the primary. 1916.

(c) Leads shall be brought out of the case through suitable bushings, which shall be sealed into the case with a compound which will not soften sufficiently to flow at any temperature less than ninety (90) degrees C. The leads shall be brought through the bushings in such manner that syphoning of oil by capillary attraction is prevented. 1916.

(d) Tap leads from high-voltage windings shall be brought to a terminal board or boards mounted inside of case in a readily accessible position, but submerged in oil. 1916.

(e) Where winding conductor is of smaller cross section than number fourteen (14) American Wire Gauge, a flexible conductor of not less than number fourteen (14) American Wire Gauge shall be used from the winding to the terminal board. 1916.

9. *Core.*

The core shall be built of laminated sheet steel so firmly assembled that no buzzing is perceptible, and shall be non-aging. 1912.

10. *Oil.*

(a) Oil shall be in accordance with R. S. A. specification for "Transformer Oil." 1916.

(b) Sufficient oil shall be furnished to completely immerse the core, windings, high-voltage terminal boards and terminals. 1916.

(c) A voltage diagram shall be placed inside the cover of each instrument.

(d) Transformers shall be fastened into the case so as to absolutely prevent the core and coils from vibrating and not permit them to be readily and quickly removed.

Hangers, rods and bolts of sufficient strength to permit complete removal of the instrument shall be furnished with each instrument.

(e) Leads out of case shall be of insulated flexible wire of a cross section not less than Number 12 wire.

(f) A standard wire harness shall be furnished with each instrument.

(g) The test leads fed from each secondary shall be of the same insulation rating as the primary lead to the primary.

(h) Leads shall be brought out through suitable bushings which shall be of a size to permit a snug fit and shall be insulated to prevent any leakage of electricity. The leads shall be brought through the case in such manner that exposure of any of the conductors to the exterior shall be prevented.

(i) Two leads from a high voltage winding shall be brought to a terminal board or leads connected inside the case in a readily accessible position on the exterior of the case.

(j) Where winding connections of smaller or less than ten thousand turns are furnished, the instrument shall be furnished with a standard wire harness (10) American Wire Gauge shall be used from the winding to the terminal board.

(k) The case shall be made of laminated sheet steel so firmly assembled that no turning is perceptible and shall be non-magnetic.

(l) Oil shall be in accordance with A. S. N. specification for transformer oil.

(m) Sufficient oil shall be furnished to completely immerse the instrument.



11. *Insulation.*

The high-voltage windings shall be insulated from the low-voltage windings by a barrier of ample dielectric strength. Each turn shall be thoroughly insulated and the voltage between adjacent turns kept as low as is consistent with good designs. Windings shall be carefully taped and leads shall be brought out in a thoroughly workmanlike manner. Windings shall be dried by the vacuum process and impregnated with an insulating compound which is not hygroscopic and not soluble in, nor acted upon by the transformer oil at operating temperatures, or else the insulating material used shall be moistureproof. The windings shall be so disposed as to permit the free circulation of oil and the maintenance of a nearly uniform temperature throughout. 1916.

12. *Tests.*

(a) Manufacturer shall give Purchaser sufficient notice of time when material will be ready for testing. 1916.

(b) Manufacturer shall provide, at point of production, apparatus and labor for making the required tests under the supervision of the Purchaser. 1916.

(c) Test shall be made at point of production or on sample submitted by the Manufacturer and may also be made upon arrival of material at destination. 1916.

(d) Tests enumerated below shall be made upon all of the transformers:

1. *Core Loss.*—Core loss and exciting current shall be taken at or corrected to seventy-five (75) degrees C. Core loss shall be measured with a wattmeter at normal frequency and voltage, using power from a generator giving a sine wave, when such is available. When a pure sine wave is not available, it shall be permissible to use any wave form which comes within the A. I. E. E. definition of a sine wave, adjusting the test voltage so that the core loss will be the same as with normal voltage and sine wave. Where voltage cannot be regulated by excitation of the generator, it must be done with auto-transformers and not by rheostats in series with the transformer to be tested. The average of the core losses of the full number of transformers of the same size on one order shall not exceed the value specified in section 17 and the maximum core loss must in no case exceed this value by more than ten (10) per cent. 1916.



12. Tests. (d)—Continued.

2. *Exciting Current.*—The average exciting current as observed during the test for core loss shall not exceed the value specified in section 17. For transformers from one (1) to five (5) K.V.A. capacity, the exciting current shall not exceed fifteen (15) per cent. of the full load current. For transformers of over five (5) K.V.A. capacity, the exciting current shall not exceed ten (10) per cent. of the full load current. With an applied voltage of ten (10) per cent. above normal, the exciting current shall in no case be more than double the percentage given for normal voltage. 1916.

3. *Copper Loss.*—The total copper loss shall be determined by separate measurements of resistances of high-voltage and low-voltage windings at or corrected to seventy-five (75) degrees C. The average copper loss of the full number of transformers of the same size on the order shall not exceed the value of the copper loss specified in section 17 and the maximum copper loss must in no case exceed this value by more than ten (10) per cent. 1916.

4. *Regulation.*—(a) With the maximum rated load at the power-factor specified on all of the circuits, the regulation of each of the windings shall not exceed the value specified in section 17. 1916.

(b) When calculated, the regulation for either the whole or part of the transformer shall be computed from the measured resistance and the reactance drop of voltage using the following expressions:

For unity power-factor:

$$\text{Per cent. regulation} = \frac{100 \text{ IR}}{\text{E}} (1)$$

For sixty (60) per cent. power-factor:

$$\text{Per cent. regulation} = \frac{(0.6 \text{ IR} + 0.8 \text{ P})}{\left( \frac{\text{E}}{\text{P}} \right)} (2)$$

where E is the rated primary voltage, P the reactance drop of voltage, I the full load primary current (not including exciting current). The equivalent resistance, R, of primary and secondary combined, is found by multiplying the secondary resistance by the square of the ratio of turns and adding to primary resistance. 1912.

test as observed during the test for any loss of  
not exceed the value specified in section 10.1.1.1  
transformers (one one (1) to two (2) K.V.A.  
applied the exciting current shall not exceed fifteen  
(15) per cent of the full load current.  
formers of over two (2) K.V.A. capacity.  
current shall not exceed ten (10) per cent of the full  
load current. With an applied voltage of 10 (10)  
per cent above normal.  
no case be more than double the value given for  
normal voltage.

be determined by separate measurements of resist-  
ances of high-voltage windings and of low-voltage  
windings to determine the ratio of the two resistances  
and apply this ratio to the value of the resistance  
of the low-voltage winding to obtain the value of the  
resistance of the high-voltage winding. The maximum  
value of the ratio shall not exceed the  
value by more than ten (10) per cent.

4. Regulation—(a) With the maximum rated load  
at the power-factor specified on all of the circuit,  
the regulation of each of the windings shall not ex-  
ceed the value specified in section 10.1.1.1.

(b) When calculated, the regulation for all of the  
winding or part of the transformer shall be calculated  
from the measured resistance and the resistance drop

$$\text{Per cent regulation} = \frac{I \cos \phi R}{E} \times 100$$

$$\text{For sixty (60) per cent power factor}$$

$$\text{Per cent regulation} = \frac{I \cos \phi R}{E} \times 100$$

where  $E$  is the rated primary voltage,  $I$  the rated  
current,  $R$  the resistance of the full load primary winding  
(not including exciting current). The equivalent re-  
sistance  $R$  of primary and secondary windings combined is  
found by multiplying the secondary resistance by  
the square of the ratio of turns and adding to  
primary resistance.



12. *Tests.* (d4)—Continued.

(c) The impedance voltage,  $e$ , is found by short-circuiting the secondary windings, and measuring the voltage necessary to send full load current through the primary. The reactance drop is then computed from the expression:

$$P = \sqrt{e^2 - I^2 R^2} \quad (3) \quad 1912.$$

The per cent. regulation shall not exceed that specified in section 17. 1916.

5. *Insulation.*—(a) The windings shall withstand for one minute an e.m.f. of ten thousand (10,000) volts alternating current, from high-voltage windings to core and low-voltage windings combined. The low-voltage windings shall withstand for one minute an e.m.f. of twice their normal voltage plus one thousand (1,000) volts between windings and from windings to core. The transformer shall be filled with oil at time the above tests are made.

1915.

(b) The windings shall withstand for one minute an impressed voltage at a suitable frequency of three (3) times the rated no load voltage. 1916.

(c) The voltages as given in section 17 shall be based on no load operation and are subject to the effect of regulation at various loads and power-factors. 1916.

(e) *Temperature Rise.*—(a) The two transformers of each size whose combined core and copper losses come nearest to the values specified in section 17 shall be selected for a heating test of that type and size. 1916.

(b) When tested for temperature rise, transformers may be overloaded and overexcited to hasten the rise of temperature to the ultimate value under normal load and the final temperature in any part, maintained for one (1) hour under constant full load and normal voltage and frequency shall not exceed the temperature of the room by more than fifty-five (55) degrees C. The rise of temperature shall be determined by the increase of resistance of the windings and by thermometer in the oil, placed as directed by the representative of the Purchaser, and the highest indicated temperature shall be taken to determine the rise. 1916.



(1) The information contained in this report is being furnished to you for your information and is not to be distributed outside your agency. The information is being furnished to you for your information and is not to be distributed outside your agency.

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13. *Aging test.*

At the option of the Purchaser, an artificial aging test may be made upon a sample of core material. 1916.

14. *Inspection.*

(a) The Purchaser shall be permitted to make such inspection of the completed product as is necessary to assure him that the requirements of the specification have been complied with. 1916.

(b) The Purchaser shall be permitted to make desired inspections at all stages of manufacture. 1916.

(c) If, upon arrival at destination, the material does not meet the requirements of this specification, it may be rejected and returned to the Manufacturer, who shall pay all freight charges. 1916.

15. *Packing.*

Material shall be packed so as to permit convenient handling and to prevent loss or damage during shipment. 1916.

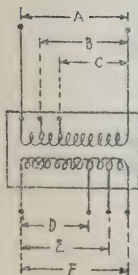
16. *Marking.*

Purchaser's order and requisition number, name of Consignor and name and address of Consignee, shall be plainly marked on outside of package. 1916.

17. *Data sheet.*

Transformers are to be used for furnishing power for operation of .....  
 Frequency .....cycles. Core loss .....watts.  
 Copper loss.....watts. Exciting current....per cent.  
 1916.

VOLTAGE, CAPACITY, POWER-FACTOR AND REGULATION TABLE



winding	Volts	Max. K.V.A.	Normal K.V.A.	P.F. Per Cent	Per cent 100% P.F	Regulation 60% P.F.
A						
B						
C						
D						
E						
F						

0105

SPECIFICATION FOR CAPPING AND GROOVED  
TRUNKING.

1916.

1. *Purpose.*

Material required under this specification is capping and grooved trunking to be used for the protection of rubber insulated wires.

2. *Finish.*

It shall be surfaced four (4) sides unless otherwise specified. Sides of groove may be sawed, but bottom shall be knife cut.

3. *Dimensions.*

(a) When surfaced four (4) sides, it shall conform to dimensions in accordance with R. S. A. drawing 1176, a variation of one-sixteenth ( $\frac{1}{16}$ ) inch either way will be allowed in outside dimensions.\*

(b) The dimensions for the groove, as shown on the drawing, shall be adhered to as a minimum, and an increase in size of one-eighth ( $\frac{1}{8}$ ) inch will be allowed as a maximum.

(c) It shall be shipped in lengths from eight (8) feet to twenty (20) feet, but no shipment shall contain less than thirty (30) per cent. of sixteen (16) feet lengths, nor more than five (5) per cent. less than ten (10) feet long. Odd lengths will be permitted.

4. *General quality.*

(a) Lumber shall be practically all heart.

(b) Knot holes will not be allowed.

(c) Shake, except as provided for elsewhere in this specification, will not be allowed.

(d) Wane will not be allowed.

(e) Any defects shall not be sufficient to impair the strength or prevent the use of any piece for the purpose intended in its full length and width.

---

\*When rough, the outside dimensions shown on the drawing shall be adhered to as a minimum, and an increase of not more than one-fourth ( $\frac{1}{4}$ ) inch will be allowed as a maximum.

# POSITION FOR CARBIDE AND GROOVES

Material required under this specification is supplied and ground turning to be used for the production of this...

It shall be understood that (1) when in less than specified, it shall be ground and turned to the specified...

(b) The dimensions for the grooves shall be shown on the drawing. When specified four (4) or more grooves are to be...

(c) It shall be supplied in lengths from one (1) foot to twenty (20) feet, and no element shall be less than...

(d) When will not be specified. (e) The grooves shall not be required to be turned in...

When rough, the outside diameter shall be shown on the drawing. It shall be shown as a minimum, and an increase of not more than one (1) inch will be allowed as a maximum.



4. *General quality.*—Continued.

(f) More than one (1) split will not be allowed in any piece of trunking and this shall not exceed in length the width of the piece. No split will be allowed in capping.

5. *White or Norway pine.*

(a) Sound tight knots, not larger than one-half ( $\frac{1}{2}$ ) inch, well scattered in any piece, will be allowed in capping.

(b) Sound tight knots, not larger than one and one-half ( $1\frac{1}{2}$ ) inches, well scattered in any piece, will be allowed in trunking.

6. *Longleaf yellow pine or fir.*

(a) Sound tight knots, not larger than one-half ( $\frac{1}{2}$ ) inch, well scattered in any piece, will be allowed in capping.

(b) Sound tight knots, not larger than one and one-half ( $1\frac{1}{2}$ ) inches, well scattered in any piece, will be allowed in trunking.

(c) Small pitch pockets, not over four (4) inches in length will be allowed.

7. *Cedar.*

(a) Lumber to be "Select Common and Better" cedar, sound and water tight.

(b) Sound tight knots, not larger than one (1) inch, well scattered in any piece, will be allowed in capping.

(c) Sound tight knots, not larger than two (2) inches, well scattered in any piece, will be allowed in trunking.

(d) Knots shall be tightly interwoven with the fiber of the surrounding wood.

8. *Cypress.*

(a) Lumber shall be what is usually known as black or red cypress, and must, in all cases, be cut within 200 miles of salt water and at an elevation under 150 feet above sea level.

(b) It shall be free of splits, coarse peck, and shall be water-tight. A very slight amount of surface peck, season checks and pin worm holes in the sides or bottom of the trunking will be allowed, provided such defects do not extend through from the outer surface into the groove. None of these defects will be allowed in capping.

(c) Sound tight knots, not larger than three-fourths ( $\frac{3}{4}$ ) inch, will be allowed in capping or trunking. Sound tight knots, not larger than two (2) inches, well scattered in any piece, will be allowed in three by four (3x4) inch



8. *Cypress.* (c)—Continued.

trunking. Sound tight knots, not larger than three (3) inches, well scattered in any piece, will be allowed in trunking larger than three by four (3x4) inches.

(d) A slight amount of shell shake that will not damage the nailing surface or cause a split will be allowed in trunking. Shell shake will not be allowed in capping.

(e) Capping one and one-half ( $1\frac{1}{2}$ ) inches thick or less shall be all heart. Capping thicker than one and one-half ( $1\frac{1}{2}$ ) inches may have one (1) inch sap in sides and one-half ( $\frac{1}{2}$ ) inch in face.

(f) Trunking three by four (3x4) inches and larger in the rough may have one (1) inch sap on the corners of the bottom measured diagonally. Trunking smaller than three by four (3x4) inches may have one-half ( $\frac{1}{2}$ ) inch sap on the corners of the bottom measured diagonally.

9. *Marking.*

The shipment shall be plainly marked to show the amount contained in the shipment, the Purchaser's order and requisition number under which furnished, the name of the Consignor, and the name of the Consignee.

10. *Acceptance and inspection.*

(a) The product of those concerns only will be accepted who have satisfied the Purchaser that the requirements of these specifications will be complied with.

(b) Inspection shall be made at the mill or at destination, at the option of the Purchaser. If inspection is to be made at the mill, the Shipper shall give the Purchaser reasonable notice to make inspection. If the specification is not met, the material will be rejected. Failure on the part of the Purchaser to make inspection at the mill shall relieve the Shipper of freight charges on rejected material from point of shipment to destination, and the Purchaser will assume the expense of handling at point of receipt and will hold such material, subject to Shipper's order, free of charge for thirty (30) days from date of inspection. After the expiration of thirty (30) days, storage at the rate of twenty-five (25) cents per thousand (1000) board feet per day shall be charged. The Shipper shall pay all freight charges for the return of rejected material.

(c) Over shipment of any kind will be entirely at the risk of the Shipper, and the Purchaser will not be responsible for its safe keeping.

- (c) Trunking. Sound tight knots, not larger than three inches well scattered in any piece, will be allowed in trunking larger than three by four (3x4) inches.
- (d) A slight amount of shell shake that will not damage the nailing surface or cause a split will be allowed in trunking. Shell shake will not be allowed in capping.
- (e) Capping one and one-half (1½) inches thick or less shall be all heart. Capping thicker than one and one-half (1½) inches may have one (1) inch sap in sides and one-half (½) inch in face.
- (f) Trunking three by four (3x4) inches and larger in the rough may have one (1) inch sap on the corners of the bottom measured diagonally. Trunking smaller than three by four (3x4) inches may have one-half (½) inch sap on the corners of the bottom measured diagonally.

## 9. Marking.

The amount contained in the manifest must be marked on the number under which the cargo is consigned, and the name of the Consignor.

## 10. Acceptance and inspection.

- (a) The product of these concerns only will be accepted who have satisfied the Purchaser that the requirements of these specifications will be complied with.
- (b) Inspection shall be made at the mill or at destination at the option of the Purchaser. If inspection is to be made at the mill, the Shipper shall give the Purchaser reasonable notice to make inspection. If the specification is not met, the material will be rejected. Failure on the part of the Purchaser to make inspection at the mill shall release the Shipper of freight charges on rejected material from point of shipment to destination, and the Purchaser will assume the expense of loading at point of receipt and will hold such material, subject to Shipper's order, free of charge for thirty (30) days from date of inspection. After the expiration of thirty (30) days, storage at the rate of twenty-five (25) cents per thousand (1,000) board feet per day shall be charged. The Shipper shall pay all freight charges for the return of rejected material.
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# THE MANUAL

OF THE

# RAILWAY SIGNAL ASSOCIATION

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## STANDARD DESIGNS

ISSUE OF 1917

Complete to December 31, 1916

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Compiled for the Board of Direction by the Editing Committee consisting of

H. S. Balliet, Chairman  
W. J. Eck, F. P. Patenall,  
C. C. Rosenberg

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Published by the Association  
BETHLEHEM, PA.



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PRINTED BY

THE RAILWAY SIGNAL ASSOCIATION, 100 N. 4TH ST., PHILADELPHIA, PA.

RECEIVED BY

H. S. Balliet, Chairman

W. J. Balliet, Secretary

C. F. Balliet, Treasurer

Published by the Association

PHILADELPHIA, PA.

## STANDARD DESIGNS

### INDEX—ALPHABETICAL

1915

TITLE.	DRAWING.
Adapter-base for ground mast signal.....	1387
Adjustable	
arm cranks and supports.....	1198
crank for signals .....	1199
link .....	1019
Adjustment, switch	
details .....	1390
insulated .....	1392
non-insulated .....	1391
Adjusting screw	
pipe .....	1002
wire .....	1001
Anchor post .....	1058
Arms, rocking shaft.....	1060
Assembly and details of	
battery chute .....	1230
battery chute, double.....	1229
battery chute, single.....	1228
bolt lock—multiple unit.....	1095
crank stand—horizontal .....	1057
crank stand—multiple unit—vertical.....	1067
crank stand—single—vertical .....	1066
deflecting stand bar.....	1069
deflecting stand bar, vertical.....	1068
detector bar.....	1098
dwarf signal mechanism .....	1097
elevator—3-cell battery .....	1227
hand rail for bracket post.....	1179
pipe carrier—assembly of.....	1085
pipe carrier—transverse .....	1072
pipe carrier—transverse .....	1073
relay box and cable post.....	1185
rocking shaft .....	1062
semaphore bearing .....	1194
switch box connections .....	1223
Bars,	
details for deflecting stands.....	1069
detector—details of .....	1098
Base, adapter, for ground mast bottom mech. sigs.....	1387
Base for	
bridge and bracket mast.....	1036
cable post .....	1180
pipe bracket post.....	1038
signal mast .....	1034
Battery,	
coppers .....	1088
elevator—details of .....	1227
zinc .....	1087



*Railway Signal Association.*

TITLE.	DRAWING.
Battery chute,	
assembly of, single and double.....	1230
double—details of .....	1229
elevator .....	1227
single—details of .....	1228
Battery, primary,	
caustic soda—signal cell .....	1053
gravity, coppers .....	1088
gravity, jar .....	1189
gravity, zinc .....	1087
Battery, storage, stationary lead type,	
box for, concrete .....	1343
box for, concrete—iron details.....	1342
connection bolt .....	1340
jars and sand trays, glass.....	1224
lead elements .....	1241
separators .....	1341
Bearings,	
crank and clamps.....	1355
double spectacle and lamp bracket.....	1356
rocker shaft .....	1061
semaphore .....	1082
Binding post .....	1070
Blades for upper quadrant signals.....	1065
Block	
filler .....	1090, 1091, 1092
terminal .....	1056
Bolt lock—multiple unit .....	1095
Bolt, connection—storage battery .....	1340
Bolts, cross-arm .....	1220
Bootlegs—terminal .....	1157
Box,	
concrete .....	1343
concrete—iron details .....	1342
junction .....	1155
relay—cast iron .....	1182
stuffing for pipe.....	1225
stuffing for wire.....	1226
terminal .....	1154
Brace for cross-arms .....	1219
Bracket—lamp .....	1049
lamp—for two-way single-lamp signal.....	1356
Bracket post,	
channel column .....	1032
clamps and stays .....	1029
crank brackets for.....	1198
deck for .....	1030
foundation for channel column, concrete.....	1105
foundation—pipe post, concrete.....	1108
guides for vertical connection on.....	1196
hand rail for—details of.....	1179
ladders .....	1028

PAGE	TITLE
1000	assembly of single and double . . . . .
1001	assembly of . . . . .
1002	assembly of . . . . .
1003	assembly of . . . . .
1004	assembly of . . . . .
1005	assembly of . . . . .
1006	assembly of . . . . .
1007	assembly of . . . . .
1008	assembly of . . . . .
1009	assembly of . . . . .
1010	assembly of . . . . .
1011	assembly of . . . . .
1012	assembly of . . . . .
1013	assembly of . . . . .
1014	assembly of . . . . .
1015	assembly of . . . . .
1016	assembly of . . . . .
1017	assembly of . . . . .
1018	assembly of . . . . .
1019	assembly of . . . . .
1020	assembly of . . . . .
1021	assembly of . . . . .
1022	assembly of . . . . .
1023	assembly of . . . . .
1024	assembly of . . . . .
1025	assembly of . . . . .
1026	assembly of . . . . .
1027	assembly of . . . . .
1028	assembly of . . . . .
1029	assembly of . . . . .
1030	assembly of . . . . .
1031	assembly of . . . . .
1032	assembly of . . . . .
1033	assembly of . . . . .
1034	assembly of . . . . .
1035	assembly of . . . . .
1036	assembly of . . . . .
1037	assembly of . . . . .
1038	assembly of . . . . .
1039	assembly of . . . . .
1040	assembly of . . . . .
1041	assembly of . . . . .
1042	assembly of . . . . .
1043	assembly of . . . . .
1044	assembly of . . . . .
1045	assembly of . . . . .
1046	assembly of . . . . .
1047	assembly of . . . . .
1048	assembly of . . . . .
1049	assembly of . . . . .
1050	assembly of . . . . .
1051	assembly of . . . . .
1052	assembly of . . . . .
1053	assembly of . . . . .
1054	assembly of . . . . .
1055	assembly of . . . . .
1056	assembly of . . . . .
1057	assembly of . . . . .
1058	assembly of . . . . .
1059	assembly of . . . . .
1060	assembly of . . . . .
1061	assembly of . . . . .
1062	assembly of . . . . .
1063	assembly of . . . . .
1064	assembly of . . . . .
1065	assembly of . . . . .
1066	assembly of . . . . .
1067	assembly of . . . . .
1068	assembly of . . . . .
1069	assembly of . . . . .
1070	assembly of . . . . .
1071	assembly of . . . . .
1072	assembly of . . . . .
1073	assembly of . . . . .
1074	assembly of . . . . .
1075	assembly of . . . . .
1076	assembly of . . . . .
1077	assembly of . . . . .
1078	assembly of . . . . .
1079	assembly of . . . . .
1080	assembly of . . . . .
1081	assembly of . . . . .
1082	assembly of . . . . .
1083	assembly of . . . . .
1084	assembly of . . . . .
1085	assembly of . . . . .
1086	assembly of . . . . .
1087	assembly of . . . . .
1088	assembly of . . . . .
1089	assembly of . . . . .
1090	assembly of . . . . .
1091	assembly of . . . . .
1092	assembly of . . . . .
1093	assembly of . . . . .
1094	assembly of . . . . .
1095	assembly of . . . . .
1096	assembly of . . . . .
1097	assembly of . . . . .
1098	assembly of . . . . .
1099	assembly of . . . . .
1100	assembly of . . . . .



*Railway Signal Association.*

TITLE.	DRAWING.
Bracket post—Continued.	
mechanical connections for 6-way.....	1190
mountings for bottom-mast mechanism cases on....	1033
pipe .....	1039
pipe—base for .....	1038
pipe head and trunking cap.....	1031
Bracket post and bridge,	
base for .....	1036
clamps for base.....	1178
mechanical connection for 3 arms.....	1191
Built-up trunking .....	1177
Bushing for cable post.....	1181
Cable post,	
assembly with relay boxes.....	1185
base for .....	1180
cap and bushing for.....	1181
Cartridge enclosed fuses.....	1309
Cell jar,	
gravity battery .....	1189
signal—primary battery .....	1053
Chain wheels,	
horizontal .....	1350
vertical .....	1351
vertical .....	1352
Channel and I beams for leadouts.....	1202
Channel column bracket post.....	1032
Channel column bracket post foundation.....	1105
Channel pins .....	1086
Charging panel,	
circuit for .....	1246
electric interlocking .....	1244
generator .....	1379
circuits for line.....	1420
line .....	1174
manipulation chart for.....	1247
two-way .....	1174
Chute—battery,	
assembly of, single and double.....	1230
double .....	1229
single .....	1228
Clamps for	
base of ground signal masts.....	1059
bridge and bracket mast.....	1178
two-way single-lamp signal.....	1355
Clamps and stays,	
ladder .....	1029
“U” bolt .....	1083
Clearance—spectacle—diagram of .....	1093



*Railway Signal Association.*

TITLE.	DRAWING.
Clip bolts—location of—detector bars.....	1099
Compensation—pipe-line—diagram and table of.....	1102
Compensators,	
cranks .....	1013
foundations .....	1104
link .....	1017
pipe—horizontal, one-way .....	1014
pipe—vertical, one-way .....	1231
Conduit, vitrified clay,	
cable—hanger sockets, sewer steps and manhole clevis .....	1334
duct .....	1335
duct reducers, mandrels, duct plugs and dowel pins..	1332
manhole, brick .....	1338
manhole, concrete .....	1337
method of laying, single and sewer pipe duct.....	1331
method of laying, single and multiple duct.....	1336
Coppers, gravity battery.....	1088
Couplers, pipe, one-inch.....	1015
Crank,	
adjusting arm, for signals.....	1199
adjusting and assembly.....	1361
arms, and support.....	1198
bracket for bracket post.....	1198
bracket fittings for pipe bracket post.....	1024, 1025
compensator pipe .....	1013
forged .....	1007
foundation, for deflecting bars and rocking shafts...	1217
foundation for, and deflecting bars.....	1203
horizontal—two-way, separate-pin .....	1393
mounted, for deflecting bars.....	1204
mountings for—or deflecting bars.....	1205
Crank stands,	
assembly of—single, vertical.....	1066
details of multiple—vertical .....	1067
foundations .....	1103
horizontal—assembly with two- and three-way....	1057
horizontal—one- and two-way .....	1011
one-way—horizontal details .....	1008
pins .....	1010
two-way—horizontal details .....	1009
two-way separate pin.....	1393
Cross-arms .....	1089
Cross-arm	
bolt .....	1220
brace .....	1219
pin, standard steel .....	1165
pin cap gauge .....	1167
pin terminal, steel.....	1166
wood .....	1089
Deck for pipe and channel column bracket post.....	1030

INDEX

1000	INDEX
1001	INDEX
1002	INDEX
1003	INDEX
1004	INDEX
1005	INDEX
1006	INDEX
1007	INDEX
1008	INDEX
1009	INDEX
1010	INDEX
1011	INDEX
1012	INDEX
1013	INDEX
1014	INDEX
1015	INDEX
1016	INDEX
1017	INDEX
1018	INDEX
1019	INDEX
1020	INDEX
1021	INDEX
1022	INDEX
1023	INDEX
1024	INDEX
1025	INDEX
1026	INDEX
1027	INDEX
1028	INDEX
1029	INDEX
1030	INDEX
1031	INDEX
1032	INDEX
1033	INDEX
1034	INDEX
1035	INDEX
1036	INDEX
1037	INDEX
1038	INDEX
1039	INDEX
1040	INDEX
1041	INDEX
1042	INDEX
1043	INDEX
1044	INDEX
1045	INDEX
1046	INDEX
1047	INDEX
1048	INDEX
1049	INDEX
1050	INDEX
1051	INDEX
1052	INDEX
1053	INDEX
1054	INDEX
1055	INDEX
1056	INDEX
1057	INDEX
1058	INDEX
1059	INDEX
1060	INDEX
1061	INDEX
1062	INDEX
1063	INDEX
1064	INDEX
1065	INDEX
1066	INDEX
1067	INDEX
1068	INDEX
1069	INDEX
1070	INDEX
1071	INDEX
1072	INDEX
1073	INDEX
1074	INDEX
1075	INDEX
1076	INDEX
1077	INDEX
1078	INDEX
1079	INDEX
1080	INDEX
1081	INDEX
1082	INDEX
1083	INDEX
1084	INDEX
1085	INDEX
1086	INDEX
1087	INDEX
1088	INDEX
1089	INDEX
1090	INDEX
1091	INDEX
1092	INDEX
1093	INDEX
1094	INDEX
1095	INDEX
1096	INDEX
1097	INDEX
1098	INDEX
1099	INDEX
1100	INDEX

TITLE.	DRAWING.
Deflecting bars,	
foundation .....	1203
foundation—cranks and rocking shafts.....	1217
mounted, crank or bars.....	1204
mounted, bars and rocking shafts.....	1206
mountings for bars or cranks.....	1205
Deflecting stand, vertical,	
details and assembly.....	1068
details of bar.....	1069
Detector bars,	
assembly and details of.....	1098
position of, and location of clip bolts.....	1099
Dwarf signals, mechanical,	
assembly of .....	1097
bearings, top and base.....	1232
fittings .....	1239
foundation .....	1106
spectacle .....	1233
Elevator—battery .....	1227
Eye rods, offset, solid jaw and solid link—detail and assembly	1195
Filler blocks .....	1090, 1091, 1092
Fittings—for one-inch pipe, operating.....	1195
Forged cranks .....	1007
Foundations for	
anchor post .....	1058
bracket post—pipe, concrete.....	1103
channel column bracket post, concrete.....	1105
compensators, concrete .....	1104
cranks .....	1103, 1203, 1217
deflecting bars and rocking shafts.....	1203, 1217
dwarf signal, concrete .....	1106
ground mast bottom mech. signals.....	1259
ground mast mechanical signals.....	1107
ladders, cast iron .....	1052
pipe carrier, concrete.....	1080
pipe carrier, cast iron, with wood top and bottom...	1109
rocking shaft .....	1200, 1217
signal mast—straight, concrete.....	1107
wheel stand, horizontal crank—concrete.....	1103
Fuses, cartridge, enclosed .....	1309
Glass jars and sand trays.....	1224
Gravity battery	
cell .....	1189
copper .....	1088
zinc .....	1087
Guide clamps, brackets and caps.....	1020
Guide clamps for vertical connection.....	1021
Guide supports and caps.....	1022
Guides for vertical connection on signals.....	1023
Guides for vertical connection on bracket post.....	1196
Hand rail for bracket post.....	1179
Horizontal	
compensator, pipe .....	1014
crank stand, one- and two-way.....	1011
crank stand assembly.....	1057
foundation for crank and wheel stands.....	1103
Hydrometer .....	1175





*Railway Signal Association.*

TITLE.	DRAWING.
I beams—leadout .....	1202
Indication locking .....	1173
Indicator—take siding. (See Specification Section.)	
Insulation,	
one-inch pipe line .....	1094
switch rod .....	1055
Jaws,	
pins .....	1010
screw, and solid .....	1016
slotted, with tang ends .....	1019
solid, with tang ends .....	1018
Jaws, for one-inch pipe,	
screw—details and assembly .....	1016, 1019
solid—details .....	1016
solid, with tang ends .....	1018, 1195
solid, with plain and threaded ends .....	1019
Junction box .....	1155
Ladders,	
clamps and stays .....	1029
for bracket post .....	1028
for two-way single-lamp signal .....	1357
foundations, cast iron .....	1052
ground mast (mechanical signals) .....	1026
parts .....	1027
top of .....	1027
Lamp, semaphore,	
bracket .....	1049
details .....	1100
equipment .....	1101
incandescent electric .....	1329
Leadaway .....	1402
Lead elements .....	1241
Leadouts,	
channel, and I beams .....	1202
mountings, for crank or deflecting bars .....	1205
cranks and deflecting bars,	
foundations for .....	1203
mounted .....	1204
cranks, deflecting bars and rocking shafts, foundation	
for .....	1217
deflecting bars and rocking shafts, mounted .....	1206
rocking shafts,	
foundation for .....	1200
mounted, high bearings .....	1201
mounted, low bearings .....	1207
Lever stand, double .....	1197
Light, marker .....	1238
Link,	
adjustable .....	1019
compensator .....	1017
solid, for bracket signals .....	1195
Location of clip bolt .....	1099
Lock, plunger .....	1096
Lock rod, adjustable .....	1237
Locking, indication .....	1173
Low rocking shaft bearing .....	1063

1902	.....	.....
1903	.....	.....
1904	.....	.....
1905	.....	.....
1906	.....	.....
1907	.....	.....
1908	.....	.....
1909	.....	.....
1910	.....	.....
1911	.....	.....
1912	.....	.....
1913	.....	.....
1914	.....	.....
1915	.....	.....
1916	.....	.....
1917	.....	.....
1918	.....	.....
1919	.....	.....
1920	.....	.....
1921	.....	.....
1922	.....	.....
1923	.....	.....
1924	.....	.....
1925	.....	.....
1926	.....	.....
1927	.....	.....
1928	.....	.....
1929	.....	.....
1930	.....	.....
1931	.....	.....
1932	.....	.....
1933	.....	.....
1934	.....	.....
1935	.....	.....
1936	.....	.....
1937	.....	.....
1938	.....	.....
1939	.....	.....
1940	.....	.....
1941	.....	.....
1942	.....	.....
1943	.....	.....
1944	.....	.....
1945	.....	.....
1946	.....	.....
1947	.....	.....
1948	.....	.....
1949	.....	.....
1950	.....	.....
1951	.....	.....
1952	.....	.....
1953	.....	.....
1954	.....	.....
1955	.....	.....
1956	.....	.....
1957	.....	.....
1958	.....	.....
1959	.....	.....
1960	.....	.....
1961	.....	.....
1962	.....	.....
1963	.....	.....
1964	.....	.....
1965	.....	.....
1966	.....	.....
1967	.....	.....
1968	.....	.....
1969	.....	.....
1970	.....	.....
1971	.....	.....
1972	.....	.....
1973	.....	.....
1974	.....	.....
1975	.....	.....
1976	.....	.....
1977	.....	.....
1978	.....	.....
1979	.....	.....
1980	.....	.....
1981	.....	.....
1982	.....	.....
1983	.....	.....
1984	.....	.....
1985	.....	.....
1986	.....	.....
1987	.....	.....
1988	.....	.....
1989	.....	.....
1990	.....	.....
1991	.....	.....
1992	.....	.....
1993	.....	.....
1994	.....	.....
1995	.....	.....
1996	.....	.....
1997	.....	.....
1998	.....	.....
1999	.....	.....
2000	.....	.....

7  
*Railway Signal Association.*

TITLE.	DRAWING.
Lug .....	1017
Machine—wall type, two lever.....	1197, 1397
Marker light .....	1238
Manipulation chart—charging panel .....	1247
Masts,	
base for bridge and bracket.....	1036
base for ground signal .....	1034
clamp for base of ground.....	1059
foundation, straight signal.....	1107
ladders for ground.....	1026
signal .....	1035
Masts, signal,	
bracket—post and bridge	
base .....	1036
clamp for base .....	1178
mechanical connections, 3-arm .....	1191
clamp and "U" bolt .....	1083
ground	
base .....	1034
clamp for base.....	1059
ladders, mechanical signals.....	1026
guides for vertical connections.....	1196
ladders, mechanical signals,	
clamps and stays.....	1029
top of .....	1027
operating fittings, one-inch pipe.....	1195
pinnacle .....	1050
Mechanical—connections for	
six- (6) way bracket post.....	1190
three- (3) way bridge and bracket post.....	1191
dwarf signal .....	1097
dwarf signal, top and base bearing.....	1232
dwarf signal fittings .....	1239
semaphore bearings .....	1082
semaphore bearing—details .....	1194
Mercury arc rectifier .....	1242
Motor panel .....	1240
Mounted deflecting bars and rocking shafts.....	1206
Mountings for cranks and deflecting bars.....	1205
Multiple unit bolt lock.....	1095
Performance, signal—forms for recording. (See Specifi- cation Section.)	
Pin,	
cap gauge .....	1167
channel .....	1086
cross-arm, standard steel .....	1165
jaw and crank .....	1010
terminal, steel .....	1166
Pinnacle .....	1050
Pins, crank and jaw.....	1010

1041	.....
1042	.....
1043	.....
1044	.....
1045	.....
1046	.....
1047	.....
1048	.....
1049	.....
1050	.....
1051	.....
1052	.....
1053	.....
1054	.....
1055	.....
1056	.....
1057	.....
1058	.....
1059	.....
1060	.....
1061	.....
1062	.....
1063	.....
1064	.....
1065	.....
1066	.....
1067	.....
1068	.....
1069	.....
1070	.....
1071	.....
1072	.....
1073	.....
1074	.....
1075	.....
1076	.....
1077	.....
1078	.....
1079	.....
1080	.....
1081	.....
1082	.....
1083	.....
1084	.....
1085	.....
1086	.....
1087	.....
1088	.....
1089	.....
1090	.....
1091	.....
1092	.....
1093	.....
1094	.....
1095	.....
1096	.....
1097	.....
1098	.....
1099	.....
1100	.....



*Railway Signal Association.*

TITLE.	DRAWING.
Pipe,	
adjusting screw, assembly .....	1002
and coupling, one-inch, signal.....	1015
bracket post, foundation .....	1108
carrier, foundation—concrete .....	1080
carrier, foundation—cast iron with wood top and bot- tom .....	1109
carrier—details and assembly.....	1085
carrier side, details of.....	1084
carrier strap .....	1071
carrier, transverse—assembly of .....	1072
carrier, transverse—details .....	1071, 1073
compensation, pipe line—diagram and table of.....	1102
compensator .....	1014
compensator, pipe, one-way, vertical.....	1231
fittings, operating, one-inch pipe.....	1195
insulation .....	1094
lug .....	1017
stuffing box, for one-inch.....	1225
Plunger lock .....	1096
Position of detector bar.....	1099
Post, anchor .....	1058
Post, binding .....	1070
Rectifier, mercury arc.....	1242
Relay box, cast iron,	
assembly, on cable post.....	1185
details, size B.....	1182
Rocking shaft,	
arms .....	1060
assembly—high bearings .....	1062
bearings, high .....	1061, 1062
bearings, low .....	1063
details .....	1061
foundations for .....	1200
foundations, cranks and deflecting bars.....	1217
mounted, and deflecting bars.....	1201, 1206
Sand tray and jar, glass.....	1224
Screw,	
jaw .....	1016, 1360
pipe adjusting .....	1002
wire adjusting .....	1001
Semaphore bearing, mechanical—details .....	1082
assembly and details.....	1194
Semaphore lamp .....	1100
Semaphore spectacle,	
clearance—diagram of .....	1093
design A .....	1040
design B .....	1041
design C .....	1235
dwarf, two-position .....	1233
filler block, to limit travel from 45° to 90°.....	1090, 1092
filler block, to limit travel from 45° to 0°.....	1091, 1092



*Railway Signal Association.*

TITLE.	DRAWING.
Semaphore spectacle.—Continued.	
filler block, to prevent travel from 0° .....	1092
torque curves for, on electric signals .....	1064
Separator, storage, stationary lead type .....	1341
Signal,	
blades .....	1065
cell .....	1053
dwarf .....	1097
mast .....	1035
one-arm mechanical, ground .....	1043
two-arm mechanical, ground .....	1044
three-arm mechanical, ground .....	1045
two-way, single, lamp .....	1236
Solid jaw, with tang ends .....	1018
Spectacle, semaphore,	
design A .....	1040
design B .....	1041
design C .....	1235
Stand, crank,	
assembly of, horizontal .....	1057
deflecting—assembly of .....	1068
horizontal, one- and two-way .....	1011
one-way .....	1008
two-way .....	1009
vertical, multiple .....	1067
vertical, single .....	1066
Stand, low target .....	1399
Stays, for ladders .....	1029
Steel pins,	
cross-arm .....	1165
terminal .....	1166
Strap, pipe carrier .....	1071
Straight signal mast—foundation .....	1107
Stuffing box,	
for one-inch pipe .....	1225
for wire .....	1226
Switch adjustments,	
details .....	1390
insulated .....	1392
non-insulated .....	1391
Symbols.	
Consist of twelve plates, as follows:	
Plates 1 and 2—signals.	
Plate 3—locations, insulated joints.	
Plate 4—relay boxes, indicators, etc.	
Plates 5 and 6—interlocked switches and derails.	
Plates 7 and 8—relays, indicators and locks.	
Plates 9 and 10—circuit controllers.	
Plate 11—circuit releases, etc.	
Plate 12—battery, electrical instruments, etc.	
These plates will be found following Standard Designs.	



*Railway Signal Association.*

TITLE.	DRAWING.
Switchboards,	
charging panel, two-way .....	1174
circuits for .....	1246
electric interlocking charging panels—one main bat-	
tery and duplicate auxiliary batteries.....	1244
knife switches and clips, details.....	1344
manipulation chart for.....	1247
mercury arc rectifier, panel.....	1242
motor panel .....	1240
single throw switches .....	1345
supports .....	1243
Switch box connections .....	1223
Table, compensation, pipe line.....	1102
Tang ends for one-inch pipe,	
lug—details .....	1017
plain and threaded .....	1019
with solid jaw .....	1018
with screw jaw .....	1360
Target stand—Low .....	1399
Terminal blocks .....	1056
Terminal box, and bootleg.....	1154
Top of ladder .....	1027
Torque curves for semaphore spectacle.....	1064
Trunking,	
bootleg terminal .....	1157
built-up .....	1177
grooved .....	1176
junction box .....	1155
to be used when wires are placed underground in	
petroleum asphaltum .....	1156
terminal box and bootleg.....	1154
Turn in pipe run.....	1400
"U" bolt and clamp.....	1083
Vertical crank stand,	
multiple .....	1067
single .....	1066
Vertical connections, guide for.....	1021, 1023
Vertical connections, guides for bracket post.....	1196
Vertical deflecting stands—details and assembly.....	1068
Wall—machine, two-lever .....	1197, 1397
Wheel,	
horizontal chain .....	1350
vertical chain, high .....	1352
vertical chain, low .....	1351
Wheel stand, horizontal crank—foundation.....	1103
Wire,	
adjusting screw .....	1001
stuffing box .....	1226
Zinc, gravity battery.....	1087



1174	as head, <i>the way</i>
1175	unit for
1176	for and double, <i>unit</i>
1177	to <i>unit</i> and other <i>unit</i>
1178	manipulation <i>unit</i>
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## STANDARD DESIGNS

### INDEX—NUMERICAL

1916

No.	TITLE.	Original.	Latest Rev.
1001.	Screw, Wire Adjusting.....	Dec., 1908	Oct., 1913
1002.	Screw, Pipe Adjusting.....	Dec., 1908	Feb., 1914
1003.	Compensator Crank—Obtuse Angle, Steel Forged (See 1013M, Nov., 1913) .....	Dec., 1908	Obsolete.
1004.	Compensator Crank—Acute Angle, Steel forged (See 1013M, Nov., 1913) .....	Dec., 1908	Obsolete.
1005.	Crank—Three-arm, Steel Forged See 1007, Nov., 1913).....	Dec., 1908	Obsolete.
1006.	Crank—Straight Arm, Steel Forged (See 1007, Nov., 1913).....	Dec., 1908	Obsolete.
1007.	Cranks—Forged, Details of (Formerly Right Angle Cranks).....	Dec., 1908	Nov., 1913
1008.	Crank Stand—One-way Horizontal, Details of (Formerly One-way Crank Stand) .....	Dec., 1908	June, 1913
1009.	Crank Stand—Two-way Horizontal, Details of (Formerly Two-way Crank Stand) .....	Dec., 1908	June, 1913
1010.	Pins—Crank and Jaw (Formerly One- and Two-way Crank Pins)...	Dec., 1908	Sept., 1915
1011.	Crank Stands—One- and Two-way Horizontal (Formerly One-way Crank Stand, Complete).....	Dec., 1908	Nov., 1913
1012.	Crank Stand—Two-way, Complete (See 1011M, Nov., 1913).....	Dec., 1908	Obsolete.
1013.	Cranks—Pipe Compensator (Formerly One-way Compensator Base, See 1014, Nov., 1913).....	Dec., 1908	Nov., 1913
1014.	Pipe Compensator—One-way Horizontal (Formerly Pipe Compensator) .....	Dec., 1908	Nov., 1913
1015.	Pipe and Coupling—One-inch, Signal	Dec., 1908	Mar., 1915
1016.	Jaw—Screw and Solid (Formerly Straight Solid Jaw, See 1018M, Nov., 1913) .....	Dec., 1908	Sept., 1916
1017.	Link, Lug and Compensator—Tang End (Formerly Offset Solid Jaw, See 1016, 1018M, Nov., 1913).....	Dec., 1908	Sept., 1916
1018.	Jaws—Solid, with Tang Ends (Formerly Wide Jaws, See 1016M, Nov., 1913) .....	Dec., 1908	Nov., 1913
1019.	Jaws—Tang End and Adjustable Link (Formerly Slotted Jaw, See 1016, 1018M, Nov., 1913).....	Dec., 1908	Sept., 1916
1020.	Guide Clamps, Bracket and Caps (Formerly Screw Jaw).....	Mar., 1915	



*Railway Signal Association.*

No.	TITLE.	Original.	Latest Rev.	
1021.	Guide Clamps for Vertical Connections on Signals (Formerly Screw Jaw Tang Ends).....	Mar., 1913		
1022.	Guide Supports and Caps for Vertical Connections on Signals (Formerly Jaw—Solid Butt End).....	Mar., 1915		
1023.	Guides for Vertical Connections on Signals .....	Mar., 1915		
1024.	Crank Bracket Fittings for Pipe Bracket Post (Formerly Link—Straight Adjustable) .....	Mar., 1915		
1025.	Crank Bracket Fittings for Pipe Bracket Post (Formerly Link—Solid Steel Forging).....	Mar., 1915		
1026.	Ladders—Ground Masts, Mechanical Signals .....	Dec., 1908		1910
1027.	Ladders, Top of.....	Dec., 1908		
1028.	Ladders for Bracket Posts and Mech. Bracket Masts .....	Dec., 1908	Mar., 1915	
1029.	Ladder Clamps and Stays.....	Dec., 1908		1910
1030.	Bracket Post—Deck for Pipe and Channel Column (Formerly St'd Pipe Signal Post, See 1035, Sept., 1914) .....	Dec., 1908	May, 1914	
1031.	Bracket Post Head and Trunking Cap, Pipe (Formerly St'd Pipe Signal Post, See 1035, Sept., 1914)....	Dec., 1908	May, 1914	
1032.	Bracket Post—Channel Column (Formerly St'd Pipe Signal Post, See 1035, Sept., 1914).....	Dec., 1908	May, 1914	
1033.	Bracket Posts—Mountings for Bottom Mast Mechanism Cases (Formerly Jaw Pins, See 1010M, Nov., 1913) .....	Dec., 1908	Sept., 1914	
1034.	Base for Ground Signal Masts (Formerly Base for 6" Signal Post)	Dec., 1908	Jan., 1914	
1035.	Masts, Signal (Formerly Ground Signal Masts) .....	Mar., 1910	Sept., 1914	
1036.	Base for Bridge and Bracket Masts.	Mar., 1910	Feb., 1914	
1037.	Bracket Post and Bridge Signal Masts (See 1035, Sept., 1914).....	Dec., 1908	1910, Obs.	
1038.	Base for Pipe Bracket Post.....	Oct., 1910	Oct., 1913	
1039.	Bracket Post, Pipe.....	Oct., 1910	May, 1914	
1040.	Spectacle—Semaphore, Design "A"..	Oct., 1909	May, 1913	
1041.	Spectacle—Semaphore, Design "B"..	Oct., 1909	May, 1913	
1042.	Rings—Spectacle (See 1041, May, 1913) .....	Oct., 1910	Obsolete.	
1043.	One-Arm Mech. Ground Signal.....	Dec., 1910	Sept., 1915	
1044.	Two-Arm Mech. Ground Signal.....	Dec., 1910	Sept., 1915	
1045.	Three-Arm Mech. Ground Signal....	Dec., 1910	Sept., 1915	
1049.	Lamp Bracket—Adjustable, Details and Assembly .....	Oct., 1910	Mar., 1914	
1050.	Pinnacle .....	Mar., 1910	Feb., 1914	
1051.	Pinnacle .....		Obsolete.	
1052.	Ladder Foundation .....	June, 1910	Dec., 1913	
1053.	Cell—Signal, Caustic Soda Primary Battery .....	Oct., 1912		





*Railway Signal Association.*

No.	TITLE.	Original.	Latest Rev.
1055.	Switch Rod Insulation (Formerly Terminal Block, (See 1056M, Jan., 1914) .....	Oct., 1909	Sept., 1914
1056.	Terminal Blocks .....	Mar., 1912	Oct., 1916
1057.	Crank Stands—Horizontal, Assembly with 2 and 3 Cranks.....	Oct., 1912	Feb., 1914
1058.	Anchor Post .....	Mar., 1913	
1059.	Clamp for Base of Ground Mast Signals .....	Oct., 1911	Sept., 1915
1060.	Rocking Shaft Arms.....	Mar., 1912	Oct., 1912
1061.	Rocking Shaft Bearings.....	Mar., 1912	Dec., 1912
1062.	Rocking Shaft—Assembly and Details .....	Mar., 1912	Dec., 1912
1063.	Rocking Shaft—Low Bearing.....	Oct., 1912	Oct., 1913
1064.	Torque Curves for Elec. Semaphore Spectacles .....	Oct., 1912	Dec., 1912
1065.	Blades for Upper Quadrant Signals..	1911	Sept., 1915
1066.	Crank Stand—Single Vertical, Details and Assembly of.....	Oct., 1911	Nov., 1913
1067.	Crank Stand—Multiple Vertical, Details of .....	Oct., 1911	Nov., 1913
1068.	Deflecting Stands—Vertical, Details and Assembly of.....	Oct., 1912	
1069.	Deflecting Stand Bar—Details of....	Oct., 1912	
1070.	Binding Post (Formerly Nut and Washer) .....	June, 1910	Sept., 1915
1071.	Pipe Carrier, Strap .....	Oct., 1911	Dec., 1913
1072.	Pipe Carriers—Transverse, Assembly of .....	Oct., 1911	Mar., 1916
1073.	Pipe Carriers—Transverse, Details of	Oct., 1911	Dec., 1913
1080.	Foundations for Pipe Carriers—Concrete .....	June, 1910	Feb., 1914
1082.	Bearing—Semaphore, Mechanical...	Oct., 1910	Sept., 1916
1083.	"U" Bolt and Clamp.....	Oct., 1910	Feb., 1914
1084.	Pipe Carrier Side.....	June, 1912	Oct., 1913
1085.	Pipe Carrier—Details and Assembly of .....	June, 1912	June, 1913
1086.	Channel Pin .....	Oct., 1910	Oct., 1912
1087.	Zinc—Gravity Battery .....	June, 1911	Oct., 1913
1088.	Coppers—Gravity Battery .....	June, 1911	Oct., 1913
1089.	Cross-arms, Wood .....	Oct., 1911	Oct., 1912
1090.	Filler Block—To Limit Travel of Signal Arms .....	Oct., 1911	Dec., 1913
1091.	Filler Block—To Limit Travel of Signal Arms .....	Oct., 1911	Dec., 1913
1092.	Filler Block—To Prevent Travel of Signal Arms .....	Oct., 1911	Dec., 1913
1093.	Spectacle Clearance—Diagram of...	Oct., 1911	Dec., 1913
1094.	Pipe Line Insulation—One-inch.....	Oct., 1911	Sept., 1916
1095.	Bolt—Lock, Multiple Unit, Details and Assembly of.....	Oct., 1911	Dec., 1914
1096.	Plunger Lock—Details and Assembly of .....	Oct., 1911	Aug., 1914
1097.	Dwarf Signal—Mechanical, Assembly of .....	Oct., 1911	Sept., 1914



4  
*Railway Signal Association.*

No.	TITLE.	Original.	Latest Rev.
1098.	Detector Bars—Details and Assembly of .....	Mar., 1912	Oct., 1912
1099.	Detector Bar—Position of and Location of Clip Bolt (Formerly Detector Bars, See 1098, Oct., 1912)...	Mar., 1912	June, 1913
1100.	Lamp, Semaphore .....	Dec., 1908	Aug., 1914
1101.	Oil Fount for Semaphore Lamp (Formerly Lamp Equipment).....	1909	April, 1914
1102.	Compensation Table, Pipe.....	Oct., 1909	Mar., 1913
1103.	Foundation for Horizontal Crank and Wheel Stands, Concrete.....	Oct., 1909	Oct., 1913
1104.	Foundation for Compensator, Concrete .....	Oct., 1909	Mar., 1913
1105.	Foundation for Channel Column Bracket Post, Concrete.....	Oct., 1909	Oct., 1913
1106.	Foundation for Dwarf Signal, Concrete .....	Oct., 1909	Mar., 1913
1107.	Foundation for Ground Mast Mechanical Signals .....	Oct., 1909	May, 1916
1108.	Foundation for Pipe Bracket Post, Concrete .....	Oct., 1909	Oct., 1913
1109.	Foundation for Pipe Carrier, Concrete .....	Dec., 1908	Dec., 1909
1154.	Box and Bootleg, Terminal.....	Dec., 1911	
1155.	Box, Junction .....	1911	
1156.	Trunking .....	Dec., 1911	
1157.	Bootleg, Terminal .....	Dec., 1911	
1165.	Pin—Steel, Cross-arm, Standard....	Mar., 1912	Oct., 1912
1166.	Pin—Steel, Terminal, Cross-arm....	Mar., 1912	Oct., 1912
1167.	Pin Cap Gauge, Cross-arm.....	Mar., 1912	
1173.	Indication Locking .....	June, 1912	
1174.	Charging Panels—Line .....	June, 1912	Sept., 1916
1175.	Hydrometer .....	May, 1915	Sept., 1916
1176.	Trunking, Grooved .....	May, 1912	
1177.	Trunking, Built-up .....	May, 1912	
1178.	Clamps for Base of Bridge and Bracket Masts .....	Oct., 1912	Feb., 1914
1179.	Handrail for Bracket Posts—Details and Assembly of.....	Oct., 1912	
1180.	Cable Post, Base for.....	June, 1912	Oct., 1912
1181.	Cable Post, Cap and Bushing for....	June, 1912	Oct., 1912
1182.	Relay Box, Cast Iron.....	June, 1912	Oct., 1912
1185.	Relay Boxes and Cable Posts, Assembly of .....	June, 1912	Oct., 1912
1189.	Jar, Gravity Cell .....	Oct., 1913	
1190.	Bracket Post—Mechanical Connections for Six-way.....	Oct., 1912	
1191.	Bridge and Bracket Masts—Mechanical Connection for Three-arm.....	Oct., 1912	
1194.	Bearings—Mechanical Semaphore, Details and Assembly of.....	Oct., 1912	May, 1916
1195.	Pipe—One-inch, Operating Fittings.	Oct., 1912	Feb., 1914
1196.	Guides for Vertical Connections on Bracket Posts .....	Oct., 1912	Mar., 1915

1902	1901	1900	1899	1898	1897	1896	1895	1894	1893	1892	1891	1890	1889	1888	1887	1886	1885	1884	1883	1882	1881	1880	1879	1878	1877	1876	1875	1874	1873	1872	1871	1870	1869	1868	1867	1866	1865	1864	1863	1862	1861	1860	1859	1858	1857	1856	1855	1854	1853	1852	1851	1850	1849	1848	1847	1846	1845	1844	1843	1842	1841	1840	1839	1838	1837	1836	1835	1834	1833	1832	1831	1830	1829	1828	1827	1826	1825	1824	1823	1822	1821	1820	1819	1818	1817	1816	1815	1814	1813	1812	1811	1810	1809	1808	1807	1806	1805	1804	1803	1802	1801	1800	1799	1798	1797	1796	1795	1794	1793	1792	1791	1790	1789	1788	1787	1786	1785	1784	1783	1782	1781	1780	1779	1778	1777	1776	1775	1774	1773	1772	1771	1770	1769	1768	1767	1766	1765	1764	1763	1762	1761	1760	1759	1758	1757	1756	1755	1754	1753	1752	1751	1750	1749	1748	1747	1746	1745	1744	1743	1742	1741	1740	1739	1738	1737	1736	1735	1734	1733	1732	1731	1730	1729	1728	1727	1726	1725	1724	1723	1722	1721	1720	1719	1718	1717	1716	1715	1714	1713	1712	1711	1710	1709	1708	1707	1706	1705	1704	1703	1702	1701	1700	1699	1698	1697	1696	1695	1694	1693	1692	1691	1690	1689	1688	1687	1686	1685	1684	1683	1682	1681	1680	1679	1678	1677	1676	1675	1674	1673	1672	1671	1670	1669	1668	1667	1666	1665	1664	1663	1662	1661	1660	1659	1658	1657	1656	1655	1654	1653	1652	1651	1650	1649	1648	1647	1646	1645	1644	1643	1642	1641	1640	1639	1638	1637	1636	1635	1634	1633	1632	1631	1630	1629	1628	1627	1626	1625	1624	1623	1622	1621	1620	1619	1618	1617	1616	1615	1614	1613	1612	1611	1610	1609	1608	1607	1606	1605	1604	1603	1602	1601	1600	1599	1598	1597	1596	1595	1594	1593	1592	1591	1590	1589	1588	1587	1586	1585	1584	1583	1582	1581	1580	1579	1578	1577	1576	1575	1574	1573	1572	1571	1570	1569	1568	1567	1566	1565	1564	1563	1562	1561	1560	1559	1558	1557	1556	1555	1554	1553	1552	1551	1550	1549	1548	1547	1546	1545	1544	1543	1542	1541	1540	1539	1538	1537	1536	1535	1534	1533	1532	1531	1530	1529	1528	1527	1526	1525	1524	1523	1522	1521	1520	1519	1518	1517	1516	1515	1514	1513	1512	1511	1510	1509	1508	1507	1506	1505	1504	1503	1502	1501	1500	1499	1498	1497	1496	1495	1494	1493	1492	1491	1490	1489	1488	1487	1486	1485	1484	1483	1482	1481	1480	1479	1478	1477	1476	1475	1474	1473	1472	1471	1470	1469	1468	1467	1466	1465	1464	1463	1462	1461	1460	1459	1458	1457	1456	1455	1454	1453	1452	1451	1450	1449	1448	1447	1446	1445	1444	1443	1442	1441	1440	1439	1438	1437	1436	1435	1434	1433	1432	1431	1430	1429	1428	1427	1426	1425	1424	1423	1422	1421	1420	1419	1418	1417	1416	1415	1414	1413	1412	1411	1410	1409	1408	1407	1406	1405	1404	1403	1402	1401	1400	1399	1398	1397	1396	1395	1394	1393	1392	1391	1390	1389	1388	1387	1386	1385	1384	1383	1382	1381	1380	1379	1378	1377	1376	1375	1374	1373	1372	1371	1370	1369	1368	1367	1366	1365	1364	1363	1362	1361	1360	1359	1358	1357	1356	1355	1354	1353	1352	1351	1350	1349	1348	1347	1346	1345	1344	1343	1342	1341	1340	1339	1338	1337	1336	1335	1334	1333	1332	1331	1330	1329	1328	1327	1326	1325	1324	1323	1322	1321	1320	1319	1318	1317	1316	1315	1314	1313	1312	1311	1310	1309	1308	1307	1306	1305	1304	1303	1302	1301	1300	1299	1298	1297	1296	1295	1294	1293	1292	1291	1290	1289	1288	1287	1286	1285	1284	1283	1282	1281	1280	1279	1278	1277	1276	1275	1274	1273	1272	1271	1270	1269	1268	1267	1266	1265	1264	1263	1262	1261	1260	1259	1258	1257	1256	1255	1254	1253	1252	1251	1250	1249	1248	1247	1246	1245	1244	1243	1242	1241	1240	1239	1238	1237	1236	1235	1234	1233	1232	1231	1230	1229	1228	1227	1226	1225	1224	1223	1222	1221	1220	1219	1218	1217	1216	1215	1214	1213	1212	1211	1210	1209	1208	1207	1206	1205	1204	1203	1202	1201	1200	1199	1198	1197	1196	1195	1194	1193	1192	1191	1190	1189	1188	1187	1186	1185	1184	1183	1182	1181	1180	1179	1178	1177	1176	1175	1174	1173	1172	1171	1170	1169	1168	1167	1166	1165	1164	1163	1162	1161	1160	1159	1158	1157	1156	1155	1154	1153	1152	1151	1150	1149	1148	1147	1146	1145	1144	1143	1142	1141	1140	1139	1138	1137	1136	1135	1134	1133	1132	1131	1130	1129	1128	1127	1126	1125	1124	1123	1122	1121	1120	1119	1118	1117	1116	1115	1114	1113	1112	1111	1110	1109	1108	1107	1106	1105	1104	1103	1102	1101	1100	1099	1098	1097	1096	1095	1094	1093	1092	1091	1090	1089	1088	1087	1086	1085	1084	1083	1082	1081	1080	1079	1078	1077	1076	1075	1074	1073	1072	1071	1070	1069	1068	1067	1066	1065	1064	1063	1062	1061	1060	1059	1058	1057	1056	1055	1054	1053	1052	1051	1050	1049	1048	1047	1046	1045	1044	1043	1042	1041	1040	1039	1038	1037	1036	1035	1034	1033	1032	1031	1030	1029	1028	1027	1026	1025	1024	1023	1022	1021	1020	1019	1018	1017	1016	1015	1014	1013	1012	1011	1010	1009	1008	1007	1006	1005	1004	1003	1002	1001	1000	999	998	997	996	995	994	993	992	991	990	989	988	987	986	985	984	983	982	981	980	979	978	977	976	975	974	973	972	971	970	969	968	967	966	965	964	963	962	961	960	959	958	957	956	955	954	953	952	951	950	949	948	947	946	945	944	943	942	941	940	939	938	937	936	935	934	933	932	931	930	929	928	927	926	925	924	923	922	921	920	919	918	917	916	915	914	913	912	911	910	909	908	907	906	905	904	903	902	901	900	899	898	897	896	895	894	893	892	891	890	889	888	887	886	885	884	883	882	881	880	879	878	877	876	875	874	873	872	871	870	869	868	867	866	865	864	863	862	861	860	859	858	857	856	855	854	853	852	851	850	849	848	847	846	845	844	843	842	841	840	839	838	837	836	835	834	833	832	831	830	829	828	827	826	825	824	823	822	821	820	819	818	817	816	815	814	813	812	811	810	809	808	807	806	805	804	803	802	801	800	799	798	797	796	795	794	793	792	791	790	789	788	787	786	785	784	783	782	781	780	779	778	777	776	775	774	773	772	771	770	769	768	767	766	765	764	763	762	761	760	759	758	757	756	755	754	753	752	751	750	749	748	747	746	745	744	743	742	741	740	739	738	737	736	735	734	733	732	731	730	729	728	727	726	725	724	723	722	721	720	719	718	717	716	715	714	713	712	711	710	709	708	707	706	705	704	703	702	701	700	699	698	697	696	695	694	693	692	691	690	689	688	687	686	685	684	683	682	681	680	679	678	677	676	675	674	673	672	671	670	669	668	667	666	665	664	663	662	661	660	659	658	657	656	655	654	653	652	651	650	649	648	647	646	645	644	643	642	641	640	639	638	637	636	635	634	633	632	631	630	629	628	627	626	625	624	623	622	621	620	619	618	617	616	615	614	613	612	611	610	609	608	607	606	605	604	603	602	601	600	599	598	597	596	595	594	593	592	591	590	589	588	587	586	585	584	583	582	581	580	579	578	577	576	575	574	573	572	571	570	569	568	567	566	565	564	563	562	561	560	559	558	557	556	555	554	553	552	551	550	549	548	547	546	545	544	543	542	541	540	539	538	537	536	535	534	533	532	531	530	529	528	527	526	525	524	523	522	521	520	519	518	517	516	515	514	513	512	511	510	509	508	507	506	505	504	503	502	501	500	499	498	497	496	495	494	493	492	491	490	489	488	487	486	485	484	483	482	481	480	479	478	477
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*Railway Signal Association.*

No.	TITLE.	Original.	Latest Rev.
1197.	Two-Lever Wall Machine (Formerly Lever Stand, Double.....	Sept., 1914	Sept., 1915
1198.	Crank Bracket for Bracket Posts (Formerly Cranks—Adjustable Arm and Support) .....	Oct., 1912	Mar., 1915
1199.	Crank for Signals—Adjusting.....	Oct., 1912	Sept., 1914
1200.	Tower Leadouts—Foundation for Rocking Shafts .....	June, 1912	
1201.	Tower Leadouts—Mounted Rocking Shafts .....	June, 1912	
1202.	Tower Leadouts—Detail of, Channel and I Beams.....	June, 1912	
1203.	Tower Leadouts—Foundation for Cranks and Deflecting Bars.....	June, 1912	
1204.	Tower Leadouts—Mounted Cranks and Deflecting Bars.....	June, 1912	
1205.	Tower Leadouts—Details of, Mountings for Crank and Deflecting Bars.	June, 1912	
1206.	Tower Leadouts—Mounted Deflecting Bars and Rocking Shafts.....	June, 1912	
1207.	Tower Leadouts—Mounted Rocking Shafts, Low Bearing .....	May, 1914	
1217.	Tower Leadouts—Foundation for Crank, Deflecting Bars and Rocking Shafts .....	Oct., 1912	
1219.	Cross-arm Brace .....	Oct., 1912	
1220.	Cross-arm Bolts .....	Oct., 1912	
1223.	Switch Box Connections.....	Oct., 1912	Aug., 1914
1224.	Jars—Storage Battery, Covers, Hold Downs, and Sand Trays (Formerly Lead Type Storage Battery).....	Oct., 1912	Mar., 1915
1225.	Stuffing Box for One-inch Pipe.....	Oct., 1912	Mar., 1913
1226.	Stuffing Box for Wire.....	Oct., 1912	Mar., 1916
1227.	Battery Elevator—Details and Assembly .....	Oct., 1912	Sept., 1916
1228.	Battery Chute—Details of Single....	Oct., 1912	Dec., 1912
1229.	Battery Chute—Details of Double....	Oct., 1912	Dec., 1912
1230.	Battery Chutes—Assembly of.....	Oct., 1912	Dec., 1912
1231.	Pipe Compensator—Vertical Type, One-way .....	Mar., 1914	
1232.	Dwarf Signal—Mechanical, Top and Base Bearing .....	Sept., 1914	
1233.	Mechanical Dwarf Signal Spectacles and Lamp Bracket Supports (Formerly Spectacle—Dwarf, Two-position, Upper Quadrant).....	Oct., 1912	Sept., 1914
1235.	Semaphore Spectacle—Design "C"....	Mar., 1916	
1236.	Signal—Two-way, Single Lamp.....	Mar., 1914	Mar., 1916
1237.	Lock Rod, Adjustable.....	May, 1914	
1238.	Marker Light .....	Mar., 1914	
1239.	Dwarf Signal Fittings, Mechanical (Formerly Details and Assembly of Switch Box Connections, See 1223).	Oct., 1913	Sept., 1914





*Railway Signal Association.*

No.	TITLE.	Original.	Latest Rev.
1240.	Motor Panel .....	Mar., 1913	
1241.	Lead elements .....	June, 1913	Mar., 1914
1242.	Mercury Arc Rectifier Panel.....	June, 1913	
1243.	Switchboard Supports .....	June, 1913	Oct., 1913
1244.	Charging Panels, Electric Interlocking .....	June, 1913	
1246.	Charging Panels, Circuits for Electric Interlocking .....	June, 1913	
1247.	Charging Panels, Manipulation Chart for Electric Interlocking.....	June, 1913	
1259.	Foundation for Ground Mast Bottom Mechanism Signals .....	May, 1916	
1309.	Fuses, Cartridge Enclosed.....	Mar., 1913	Oct., 1914
1329.	Incandescent Electric Lamps.....	Sept., 1914	
1331.	Pipe Duct, Method of Laying Single and Sewer .....	Oct., 1913	Sept., 1914
1332.	Duct Reducers, Mandrels, Duct Plugs and Dowel Pins.....	Oct., 1913	Sept., 1914
1333.	Manhole Frame, 10" high, and Cover	Oct., 1913	Sept., 1914
1334.	Cable Hanger Sockets, Sewer Steps and Manhole Clevis.....	Oct., 1913	Sept., 1914
1335.	Duct, Vitrified Clay .....	Oct., 1913	
1336.	Duct, Method of Laying Single and Multiple .....	Oct., 1913	
1337.	Manhole, Concrete .....	Oct., 1913	Sept., 1914
1338.	Manhole, Brick .....	Oct., 1913	Sept., 1914
1339.	Manhole Frame, 4" high, and Cover.	May, 1914	Sept., 1914
1340.	Bolt—Storage Battery Connection, Lead Type .....	Mar., 1914	
1341.	Separator—Storage Battery, Lead Type .....	Sept., 1914	
1342.	Box, Concrete—Storage Battery, Iron Details .....	Mar., 1914	
1343.	Box, Concrete—Storage Battery....	Mar., 1914	Sept., 1916
1344.	Knife Switches and Clips.....	Mar., 1914	
1345.	Switches, Single Throw.....	Mar., 1914	
1350.	Chain Wheels, Horizontal.....	Oct., 1913	
1351.	Chain Wheels, Vertical.....	Oct., 1913	
1352.	Chain Wheels, Vertical.....	Oct., 1913	
1355.	Crank Bearings and Clamps.....	Mar., 1916	
1356.	Bearing, Double Spectacle and Lamp Bracket .....	Mar., 1916	
1357.	Ladders for Two-way Single-Lamp Signal .....	Mar., 1916	
1260.	Tang Ends with Screw Jaw.....	Sept., 1915	
1361.	Adjusting Crank and Assembly....	May, 1915	
1379.	Charging Panels, Generator.....	Sept., 1916	
1387.	Adapter—Base of Ground Mast Bottom Mechanism Signals.....	May, 1916	Sept., 1916
1388.	Graphical Representation of Electric Energy Supply for Power Interlocking .....	Sept., 1915	
1289.	Graphical Representation of Air Supply for Pneumatic Interlocking	May, 1915	



*Railway Signal Association.*

No.	TITLE.	Original.	Latest Rev.
1290.	Switch Adjustment—Details.....	May, 1915	Sept., 1916
1391.	Switch Adjustment—Non-insulated..	May, 1915	Sept., 1916
1392.	Switch Adjustment—Insulated.....	Sept., 1916	
1393.	Crank Stand, Horizontal—Two-way Separate-pin .....	Sept., 1916	
1397.	Two-Lever Wall Machine.....	Sept., 1915	
1399.	Low Target Stand.....	Mar., 1916	
1400.	Turn in Pipe Run.....	Mar., 1916	June, 1916
1402.	Leadaway .....	Mar., 1916	June, 1916
1420.	Circuits for Line Charging Panels...	Sept., 1916	

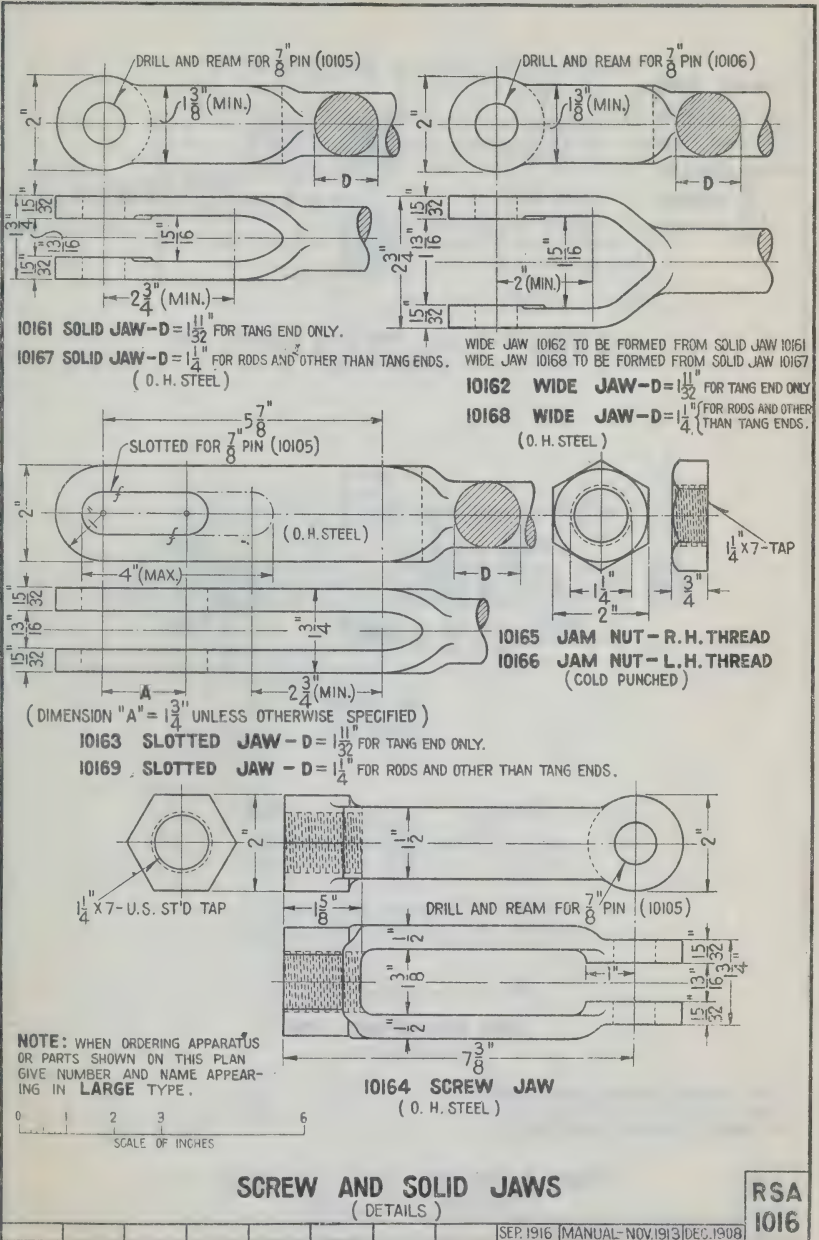
Year	Month	Day	Time	Location	Remarks
1918	Jan	1	10:00	Station	Arrived - (Sawyer)
1918	Jan	2	10:00	Station	Arrived - (Sawyer)
1918	Jan	3	10:00	Station	Arrived - (Sawyer)
1918	Jan	4	10:00	Station	Arrived - (Sawyer)
1918	Jan	5	10:00	Station	Arrived - (Sawyer)
1918	Jan	6	10:00	Station	Arrived - (Sawyer)
1918	Jan	7	10:00	Station	Arrived - (Sawyer)
1918	Jan	8	10:00	Station	Arrived - (Sawyer)
1918	Jan	9	10:00	Station	Arrived - (Sawyer)
1918	Jan	10	10:00	Station	Arrived - (Sawyer)
1918	Jan	11	10:00	Station	Arrived - (Sawyer)
1918	Jan	12	10:00	Station	Arrived - (Sawyer)
1918	Jan	13	10:00	Station	Arrived - (Sawyer)
1918	Jan	14	10:00	Station	Arrived - (Sawyer)
1918	Jan	15	10:00	Station	Arrived - (Sawyer)
1918	Jan	16	10:00	Station	Arrived - (Sawyer)
1918	Jan	17	10:00	Station	Arrived - (Sawyer)
1918	Jan	18	10:00	Station	Arrived - (Sawyer)
1918	Jan	19	10:00	Station	Arrived - (Sawyer)
1918	Jan	20	10:00	Station	Arrived - (Sawyer)
1918	Jan	21	10:00	Station	Arrived - (Sawyer)
1918	Jan	22	10:00	Station	Arrived - (Sawyer)
1918	Jan	23	10:00	Station	Arrived - (Sawyer)
1918	Jan	24	10:00	Station	Arrived - (Sawyer)
1918	Jan	25	10:00	Station	Arrived - (Sawyer)
1918	Jan	26	10:00	Station	Arrived - (Sawyer)
1918	Jan	27	10:00	Station	Arrived - (Sawyer)
1918	Jan	28	10:00	Station	Arrived - (Sawyer)
1918	Jan	29	10:00	Station	Arrived - (Sawyer)
1918	Jan	30	10:00	Station	Arrived - (Sawyer)
1918	Jan	31	10:00	Station	Arrived - (Sawyer)

TABLE II

STATION & TIME

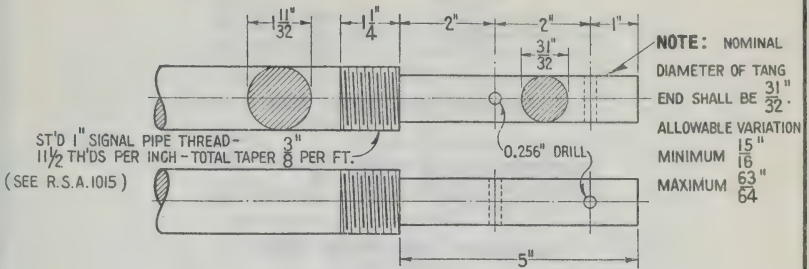


# Railway Signal Association.

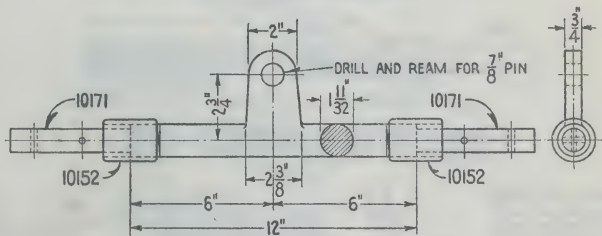




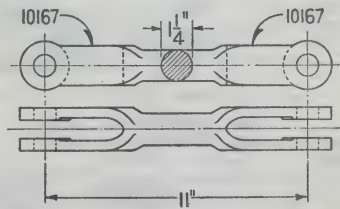
# *Railway Signal Association.*



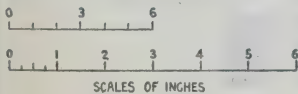
**10171 DETAIL OF TANG END** (FOR 1" SIGNAL PIPE)  
(O. H. STEEL)



**10172 LUG**  
(O. H. STEEL)



**10173 COMPENSATOR LINK**  
(O. H. STEEL)



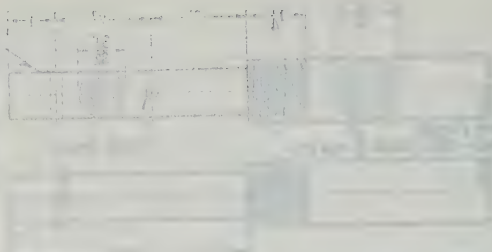
**NOTE:** WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN LARGE TYPE.

**TANG END - LUG AND COMP. LINK**  
(DETAILS AND ASSEMBLY)

**RSA**  
**1017**

SEP. 1916 / MANUAL - NOV. 1913 / DEC. 1908

NOTE: WHEN DIMENSIONS ARE GIVEN IN PARENTS, THE DIMENSIONS IN PARENTS ARE THE DIMENSIONS OF THE PARTS AND THE DIMENSIONS IN BRACKETS ARE THE DIMENSIONS OF THE ASSEMBLY.



JOINT DETAIL OF TANG END LINK (FOR 1/2" BORE TANG)



TANG END LINK (FOR 1/2" BORE TANG)

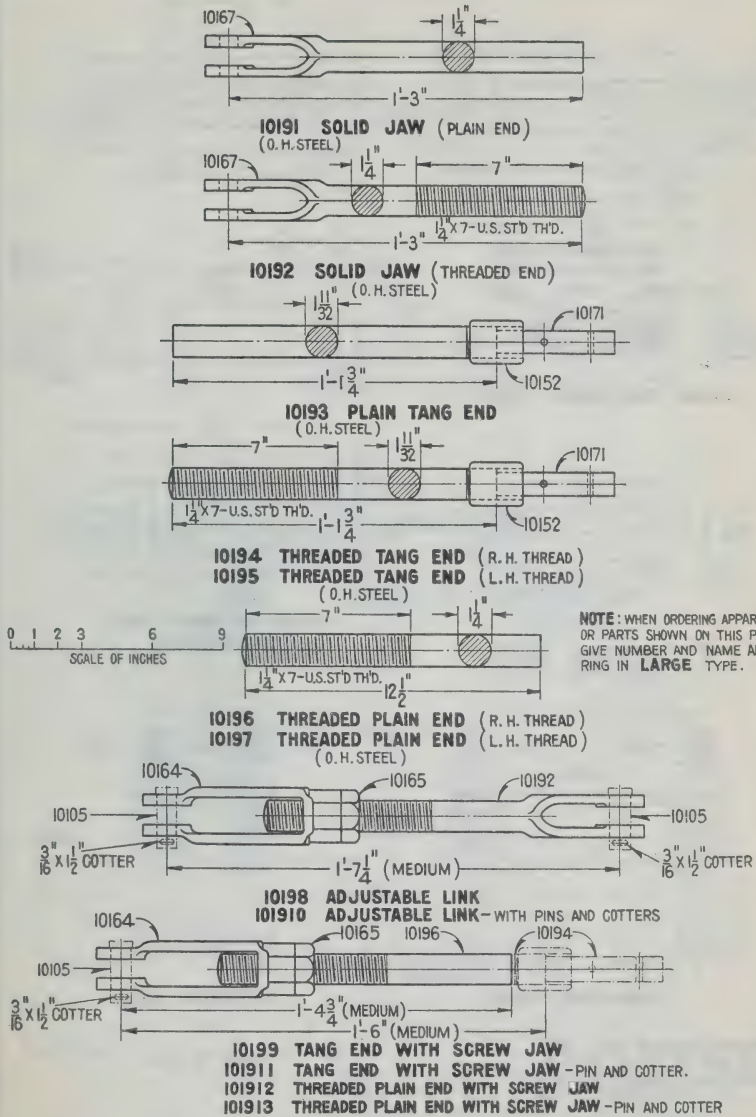


TANG END LINK (FOR 1/2" BORE TANG)

NOTE: WHEN DIMENSIONS ARE GIVEN IN PARENTS, THE DIMENSIONS IN PARENTS ARE THE DIMENSIONS OF THE PARTS AND THE DIMENSIONS IN BRACKETS ARE THE DIMENSIONS OF THE ASSEMBLY.

# TANG END-LINK AND COMP LINK (DETAILS AND ASSEMBLY)

FIG. 24



NOTE: WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN LARGE TYPE.

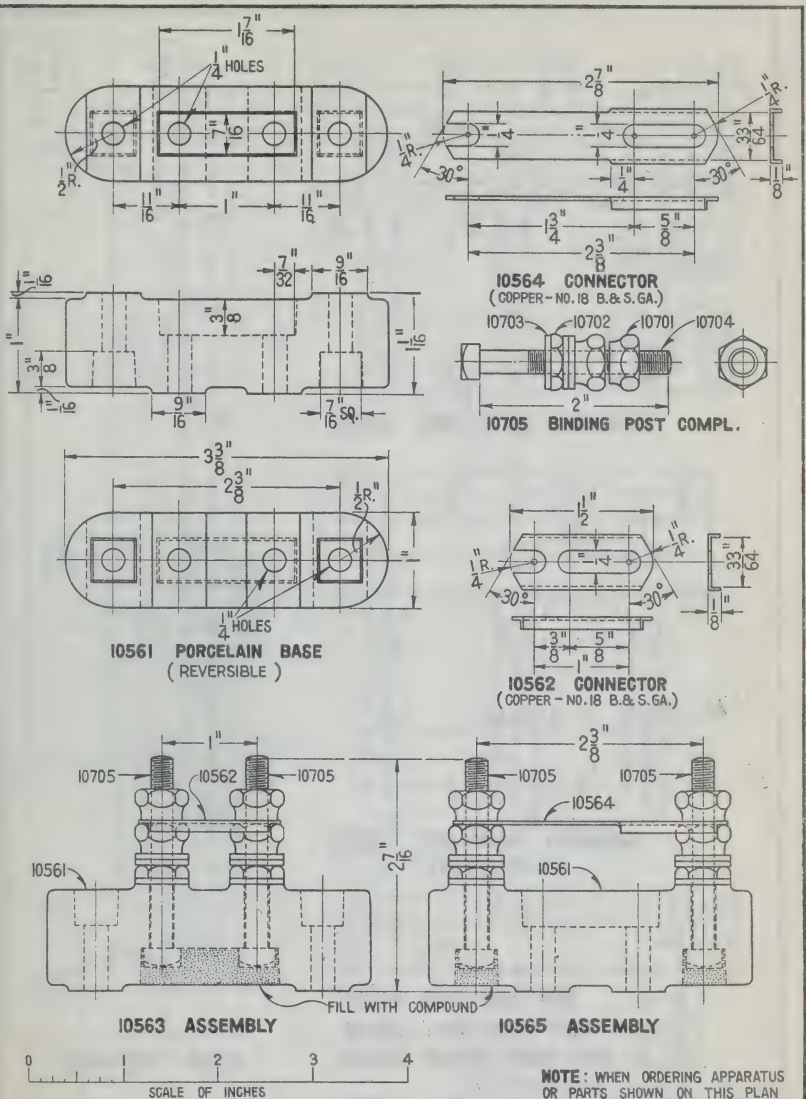
**JAWS-TANG END AND ADJUSTABLE LINK**  
(DETAILS AND ASSEMBLY)

**RSA**  
**1019**





# Railway Signal Association.

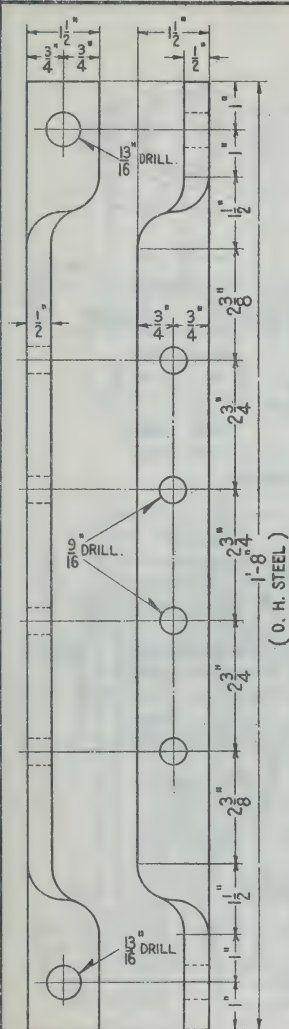


## TERMINAL BLOCKS (DETAILS AND ASSEMBLY)

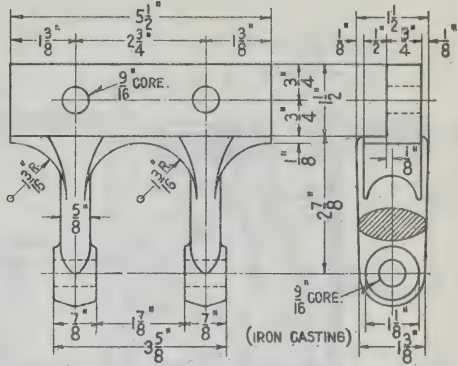
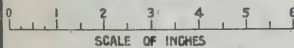
RSA  
1056

M-10-1916 MAY 1915 M-1-1914 MAR. 1912

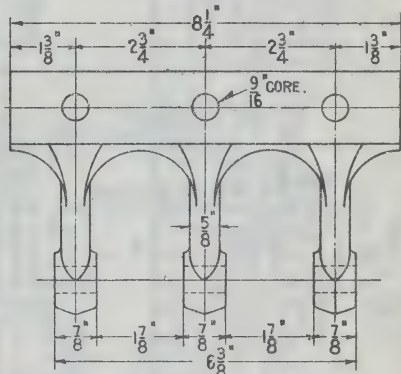




**SUPPORT 10731**

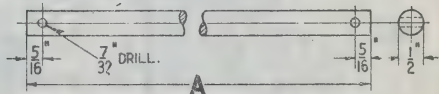


**10732 ONE-WAY HANGER**



**10733 TWO-WAY HANGER**

(IRON CASTING)



**10734 ONE-WAY PIN** (A = 4 1/2)

**10735 TWO-WAY PIN** (A = 7 1/4)

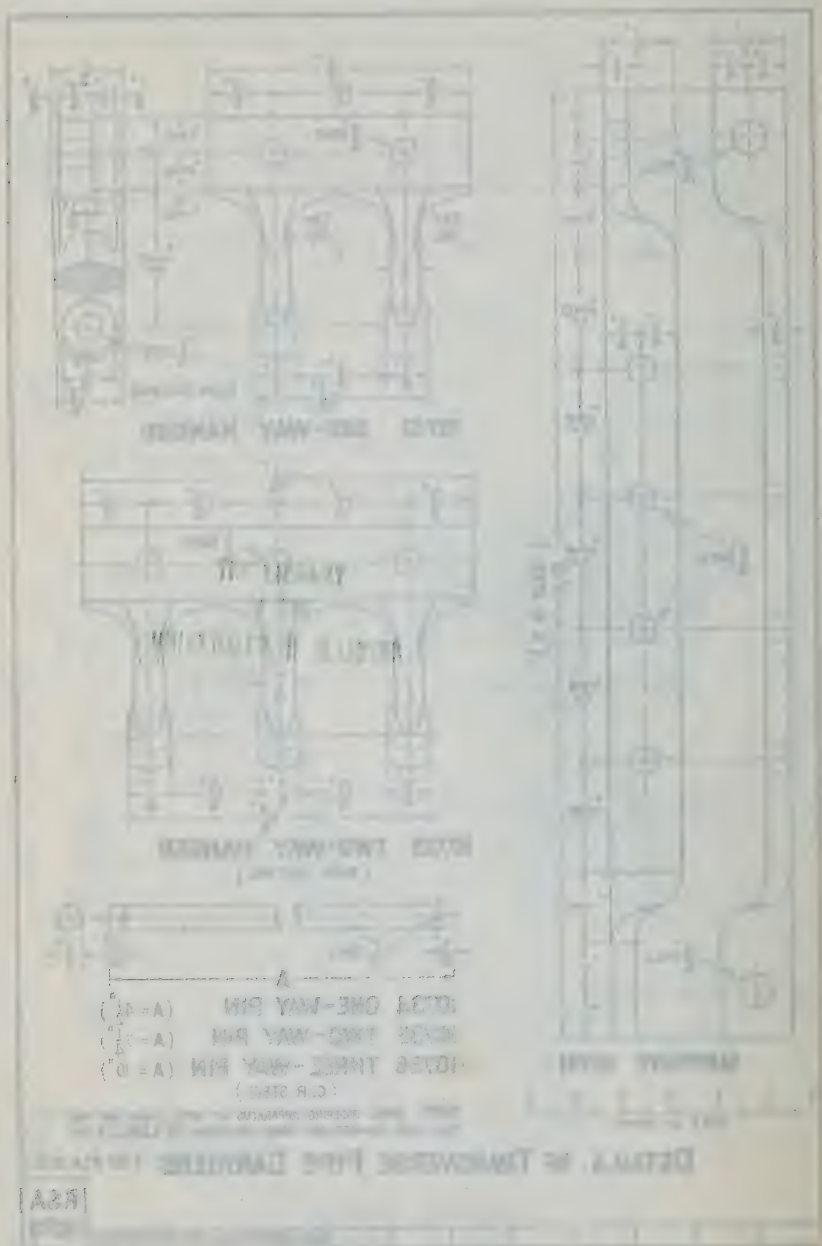
**10736 THREE-WAY PIN** (A = 10)

(C. R. STEEL)

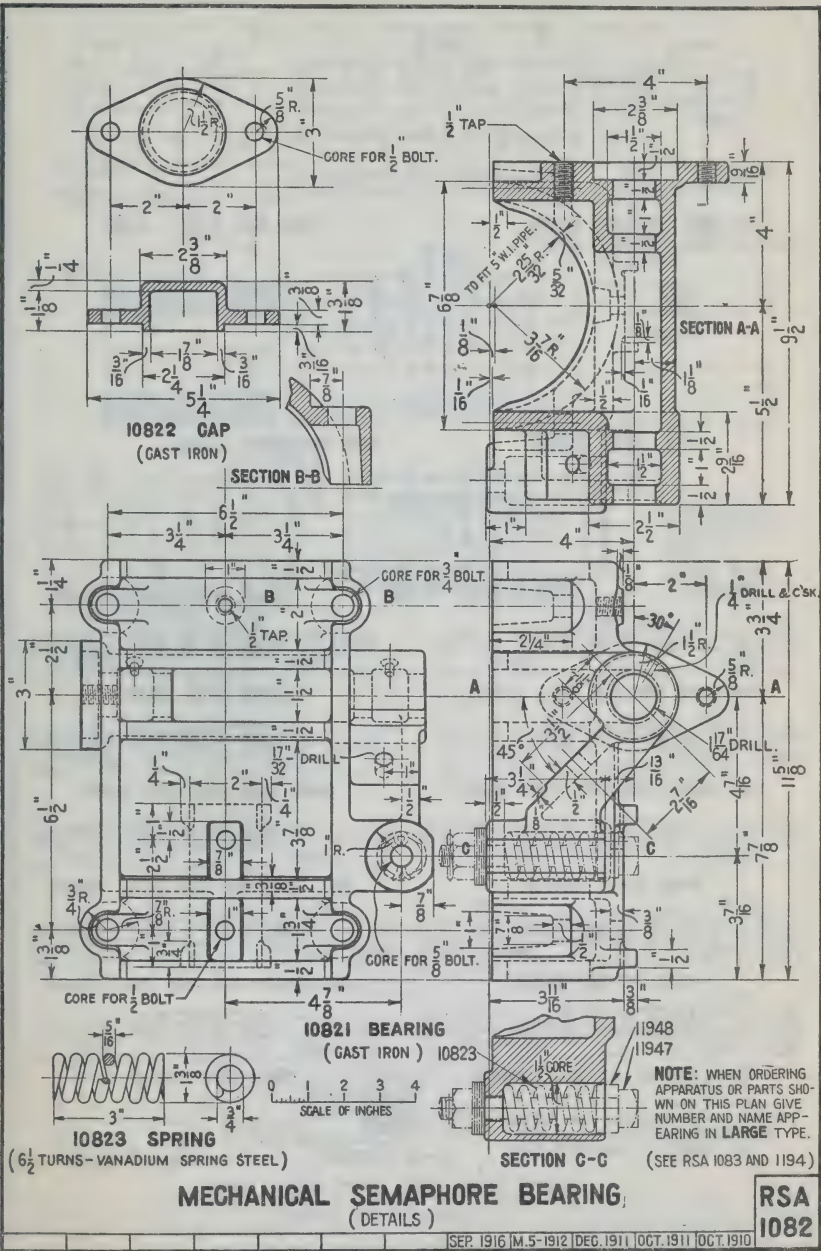
NOTE: WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN LARGE TYPE

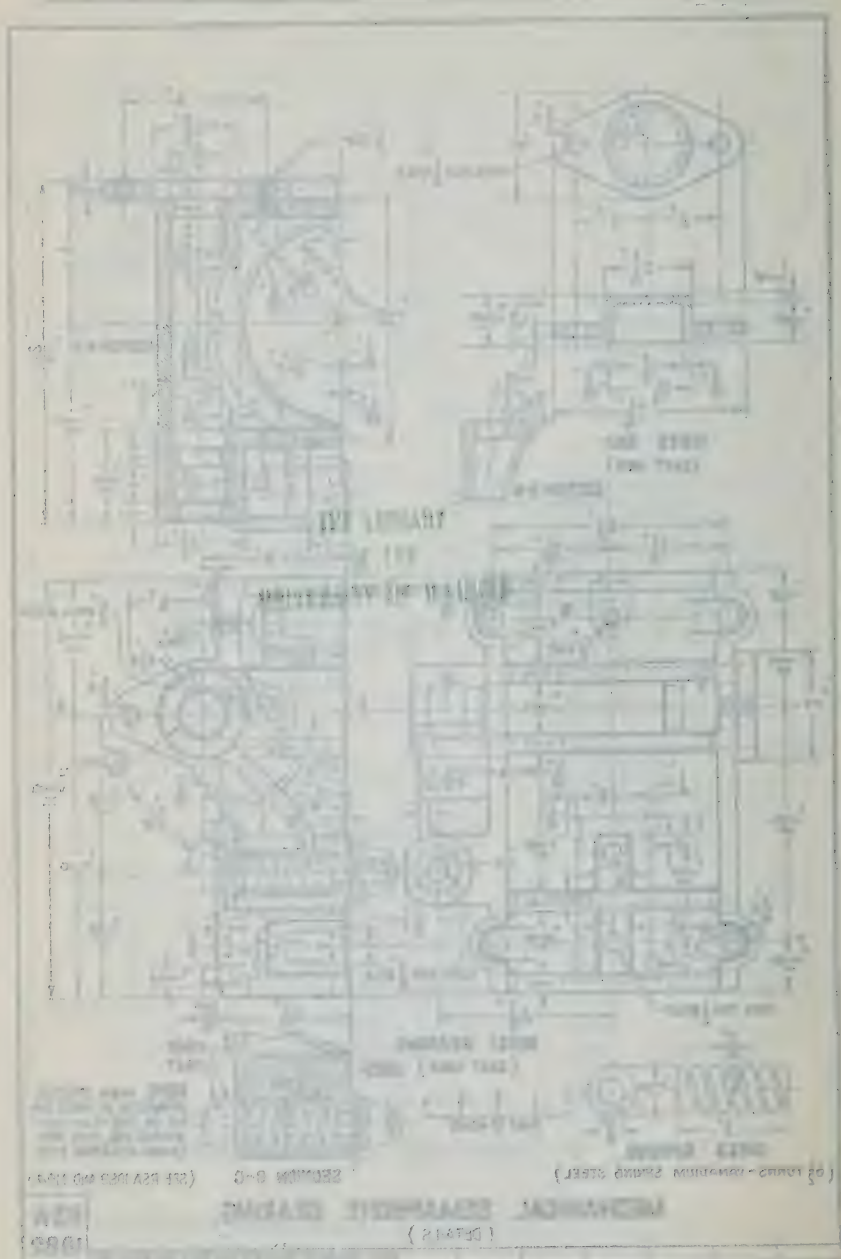
**DETAILS OF TRANSVERSE PIPE CARRIERS (SEE RSA 1072)**

**RSA  
1073**

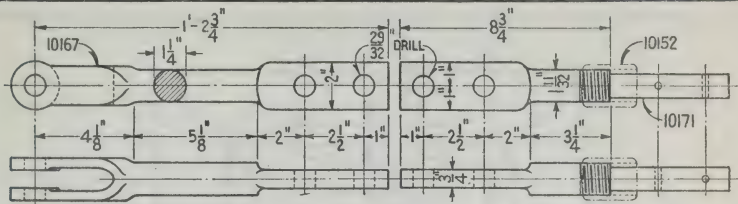






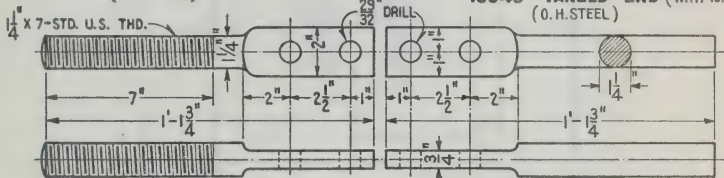


# Railway Signal Association.



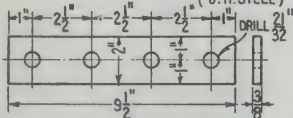
**10941 SOLID JAW END**  
(O. H. STEEL)

**10942 TANGED END (ONLY)**  
**10943 TANGED END (WITH 10152)**  
(O. H. STEEL)

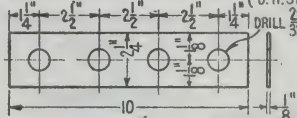


**10944 THREADED END**  
(O. H. STEEL)

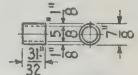
**10945 BUTT END**  
(O. H. STEEL)



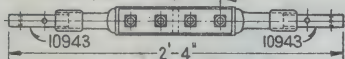
**10946 CONNECTING PLATE**  
(O. H. STEEL)



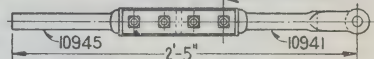
**10947 FIBRE PLATE**



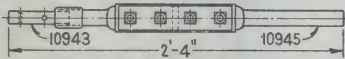
**10948 FIBRE BUSHING**



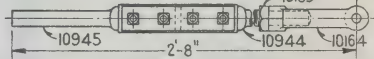
**10949 TANG ENDS**



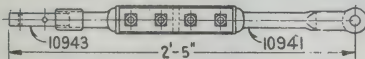
**10941 BUTT END AND SOLID JAW**



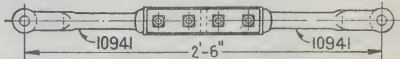
**109410 TANG AND BUTT ENDS**



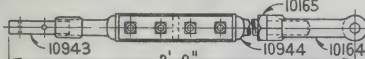
**109415 BUTT END AND SCREW JAW**



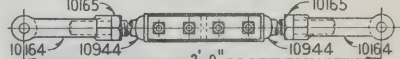
**109411 TANG END AND SOLID JAW**



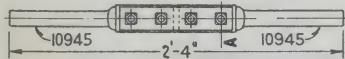
**109416 SOLID JAWS**



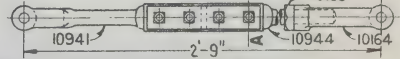
**109412 TANG END AND SCREW JAW**



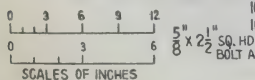
**109417 SCREW JAWS**



**109413 BUTT ENDS**



**109418 SOLID AND SCREW JAWS**



**SECTION A-A**

**NOTE:** WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN LARGE TYPE

## ONE INCH PIPE LINE INSULATION (DETAILS AND ASSEMBLY)

**RSA  
1094**

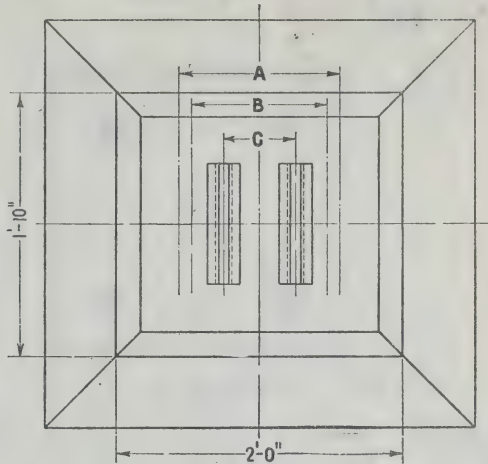
SEP. 1916 MAR. 1914 OCT. 1911

0-0 1621-352

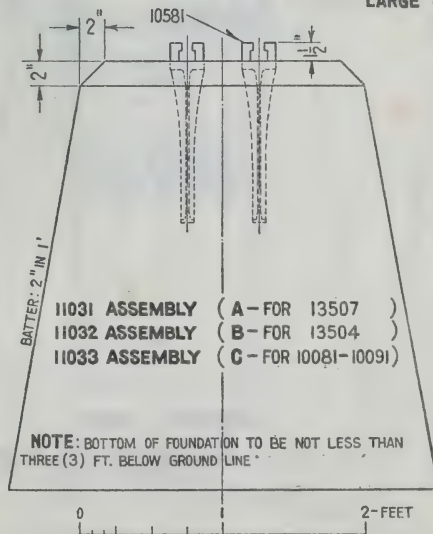
THE UNIVERSITY OF CHICAGO

A 23





NOTE: WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN LARGE TYPE.

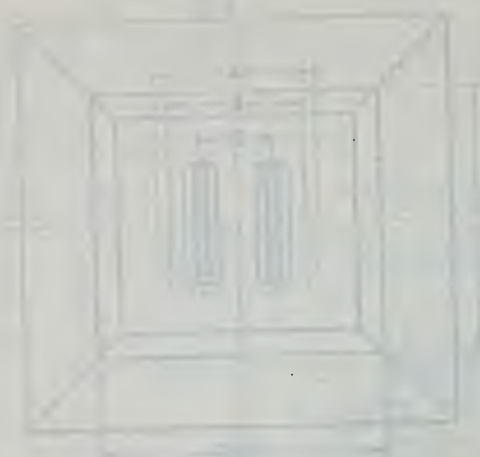


CONCRETE FOUNDATION FOR HORIZONTAL CRANK AND WHEEL STANDS

RSA  
1103

OCT. 1913 OCT. 1909

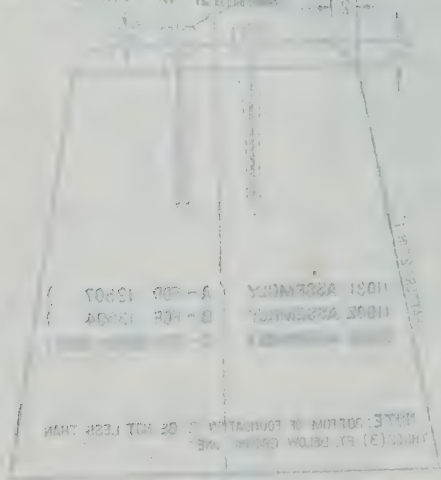




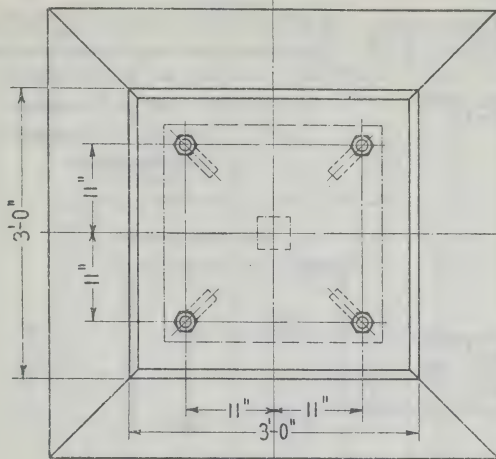
# THE LIBRARY

NOTE: WHEN ORDERING, SPECIFY THE PARTS NUMBER AND THE QUANTITY OF EACH PART REQUIRED.

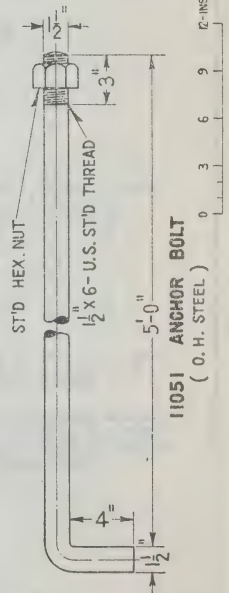
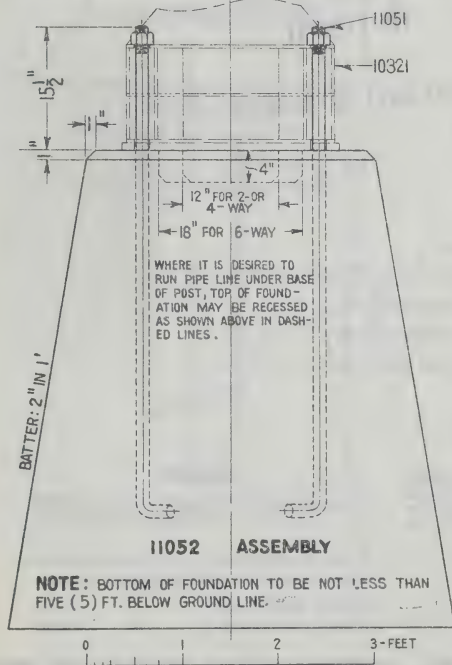
REVISION 1.0



NOTE: BOTTOM OF FOUNDATION IS NOT LESS THAN 100 (3) FT. BELOW GROUND LINE.



NOTE: WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN LARGE TYPE.



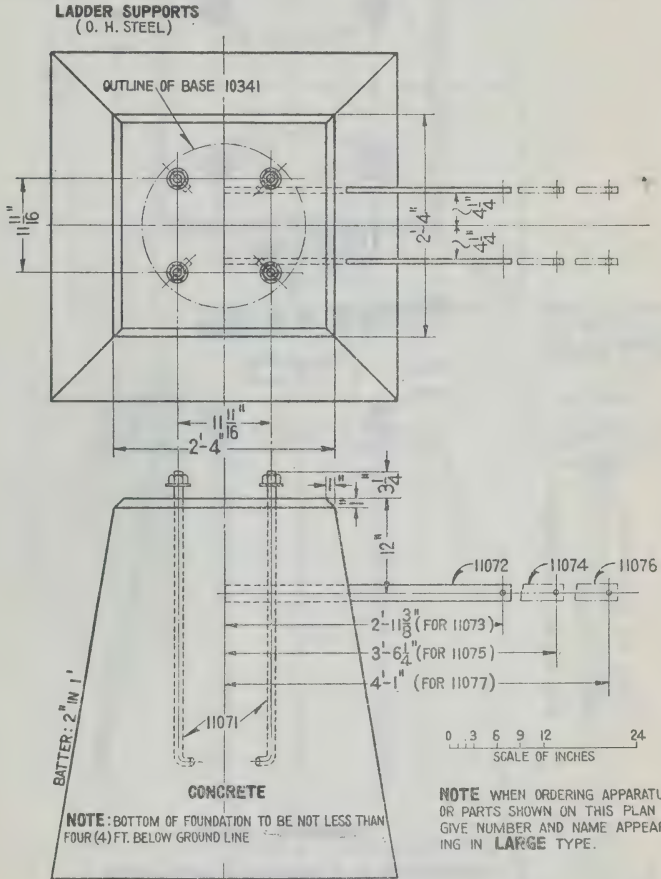
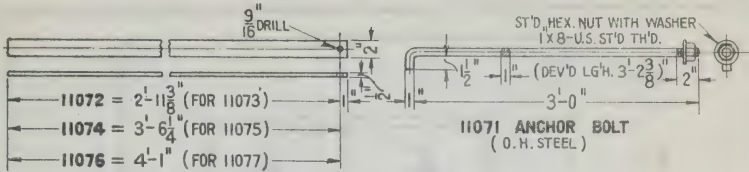
CONCRETE FOUNDATION FOR CHANNEL COLUMN BRACKET POST

RSA  
1105

OCT. 1913 OCT. 1909



# Railway Signal Association.



- 11073 ASSEMBLY (FOR 1-ARM LADDER)
- 11075 " (FOR 2-ARM LADDER)
- 11077 " (FOR 3-ARM LADDER)

FOUNDATION FOR GROUND MAST MECHANICAL SIGNALS

MAY 1916/M-3-1915 OCT. 1909

RSA  
 1107

1. 1/2" = 1'-0" (FOR 1072)  
 2. 3/4" = 1'-0" (FOR 1072)  
 3. 1" = 1'-0" (FOR 1072)

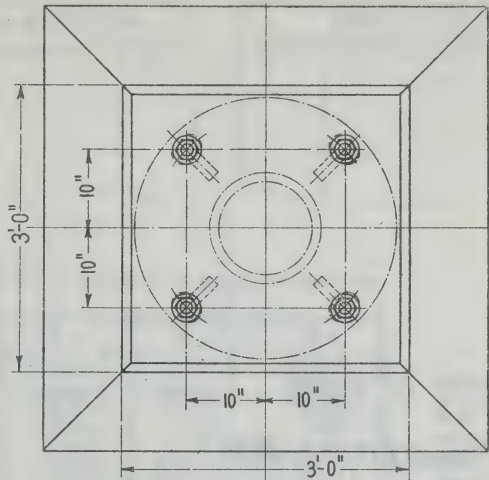
1072 = 2'-11 1/8" (FOR 1072)  
 1074 = 3'-0" (FOR 1072)  
 1076 = 4'-1" (FOR 1072)  
 LADDER SUPPORTS  
 (0.1" STEEL)



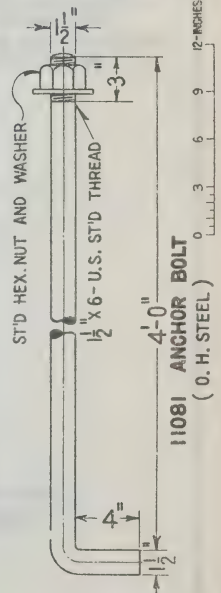
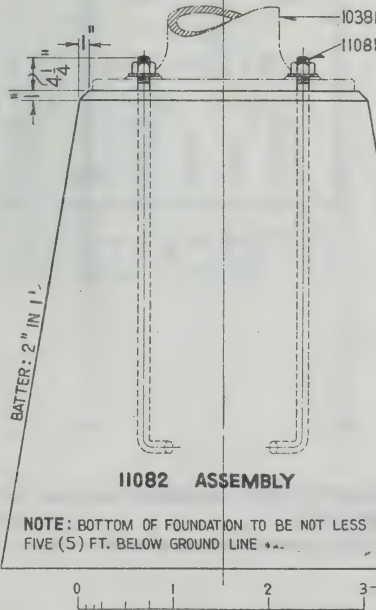
1. 1/2" = 1'-0" (FOR 1072)  
 2. 3/4" = 1'-0" (FOR 1072)  
 3. 1" = 1'-0" (FOR 1072)

1072 (FOR 1072) 1074 (FOR 1072) 1076 (FOR 1072)





NOTE: WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN **LARGE** TYPE.



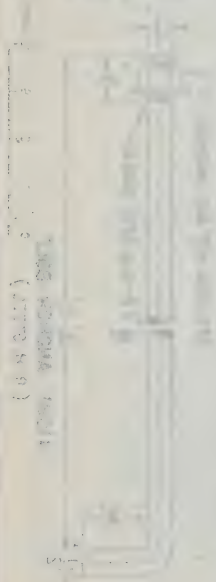
CONCRETE FOUNDATION FOR PIPE BRACKET POST

RSA  
1108

OCT. 1913 OCT. 1909



NOTES: 1. THE DISTANCE BETWEEN THE CENTERS OF THE CIRCLES IS 10 INCHES. 2. THE DISTANCE FROM THE CENTER OF EACH CIRCLE TO THE NEAREST CORNER OF THE SQUARE IS 10 INCHES. 3. THE DISTANCE FROM THE CENTER OF EACH CIRCLE TO THE NEAREST SIDE OF THE SQUARE IS 10 INCHES. 4. THE DISTANCE FROM THE CENTER OF EACH CIRCLE TO THE NEAREST CORNER OF THE SQUARE IS 10 INCHES.



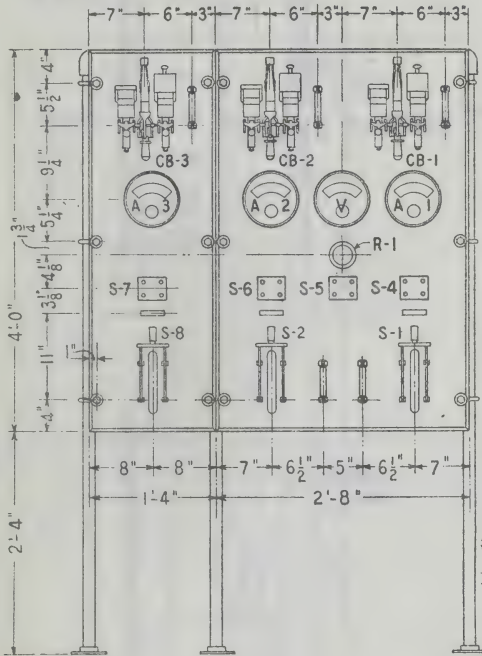
1000

UNCLASSIFIED, DATE 12-10-2010

# Railway Signal Association.

BILL OF MATERIAL		
REQ. NO.	DESCRIPTION	DESIGN. NO.

MANIPULATION CHART	
FUNCTION	MANIPULATION IN ORDER OF PROCEDURE



**NOTES:** PANELS SHALL BE OF 1 1/2" OIL FINISHED BLACK SLATE WITH 1/8" X 1/8" BEVEL.  
SUPPORTS SHALL BE IN ACCORDANCE WITH RSA 1243.  
COMPLETE BILL OF MATERIAL AND MANIPULATION CHART SHALL BE FURNISHED WITH EACH CHARGING PANEL.  
CIRCUITS SHALL BE IN ACCORDANCE WITH RSA 1420.

- 11741 TWO WAY CHARGING PANEL COMPLETE.  
11742 ONE " " " FOR ADDITION TO 11741.  
11743 ONE AND TWO WAY CHARGING PANELS COMPLETE.

## LINE CHARGING PANELS ( 600 VOLTS OR LESS.)

**RSA  
1174**

SEPT. 1916 JUNE 1912

General Information	
Project Name	
Location	
Contract No.	

Project Details	
Design No.	
Revision	
Date	

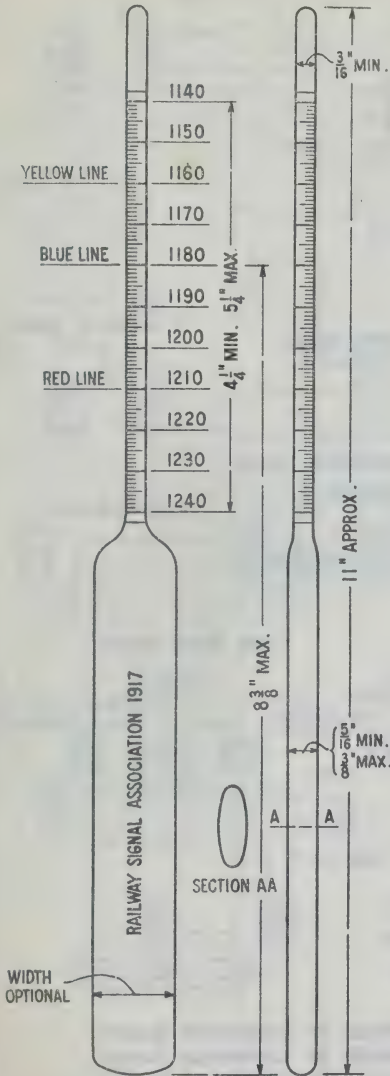
1. Project Name: [REDACTED]  
 2. Location: [REDACTED]  
 3. Contract No.: [REDACTED]  
 4. Design No.: [REDACTED]  
 5. Revision: [REDACTED]  
 6. Date: [REDACTED]  
 7. Project Description: [REDACTED]  
 8. Project Objectives: [REDACTED]  
 9. Project Scope: [REDACTED]  
 10. Project Risks: [REDACTED]



1. Project Name: [REDACTED]  
 2. Location: [REDACTED]  
 3. Contract No.: [REDACTED]  
 4. Design No.: [REDACTED]  
 5. Revision: [REDACTED]  
 6. Date: [REDACTED]  
 7. Project Description: [REDACTED]  
 8. Project Objectives: [REDACTED]  
 9. Project Scope: [REDACTED]  
 10. Project Risks: [REDACTED]

# LINE CHARGING PANELS

*Railway Signal Association.*



**NOTE :** INSTRUMENTS SHALL BE ACCURATE WITHIN TWO (2) DEGREES.  
 SPECIFIC GRAVITY SCALE OF HYDROMETER SHALL BE GRADUATED FOR ELECTROLYTE AT 70° FAHRENHEIT  
 HYDROMETER SHALL BE FURNISHED IN TUBULAR CONTAINER WITH TELESCOPE COVER.

**NOTE :** WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN **LARGE TYPE**.

**11751 - HYDROMETER.**

**HYDROMETER**  
 (STATIONARY LEAD TYPE STORAGE BATTERY.)

**RSA**  
**1175**

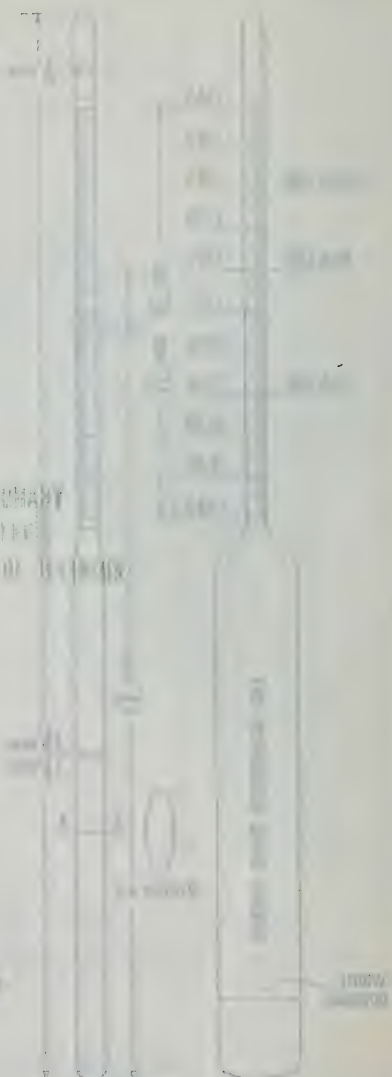
SEPT. 1916 MAR. 1916 MAY 1915



NOTE: INSTRUMENT SHALL BE ADJUSTED  
 TO READ ZERO (0) BEFORE  
 EACH USE. AFTER EACH USE, THE  
 INSTRUMENT SHALL BE STORED IN A  
 PROTECTED PLACE.

WATER-LEVEL MEASUREMENT  
 INSTRUMENT

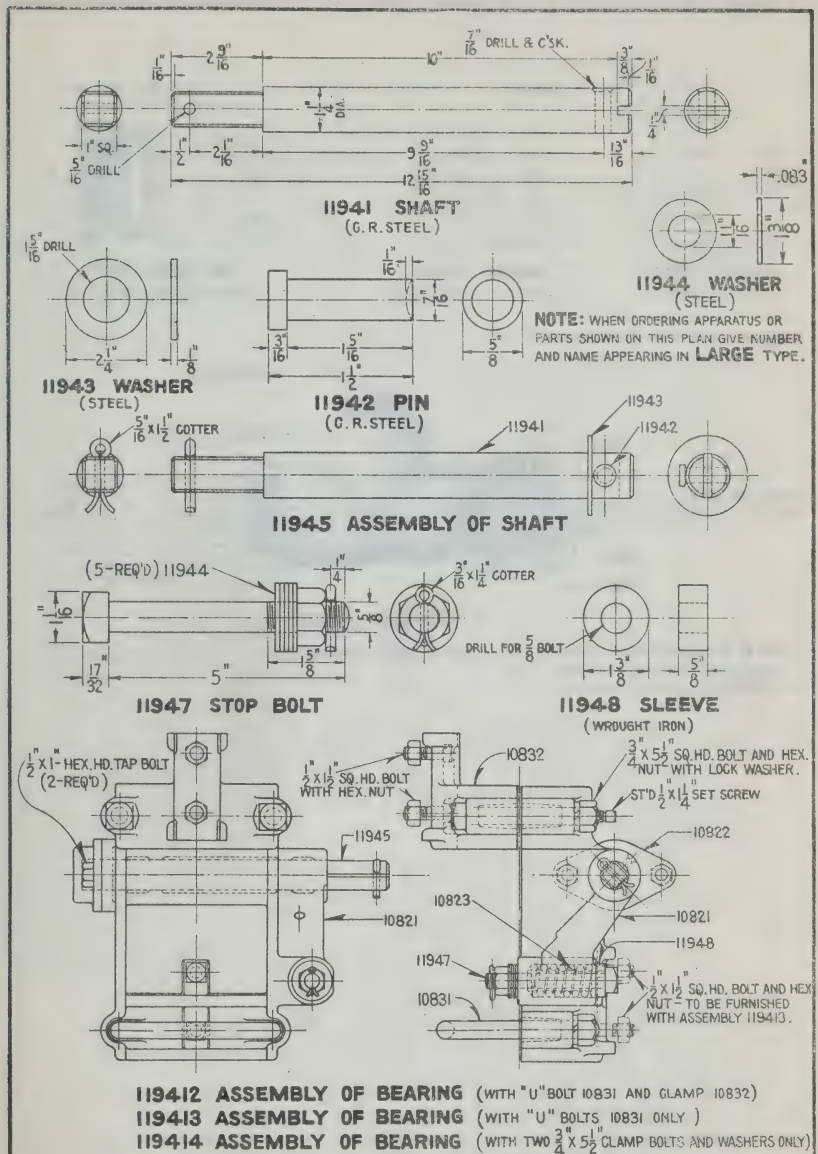
WATER-LEVEL MEASUREMENT  
 INSTRUMENT



HYDROMETER

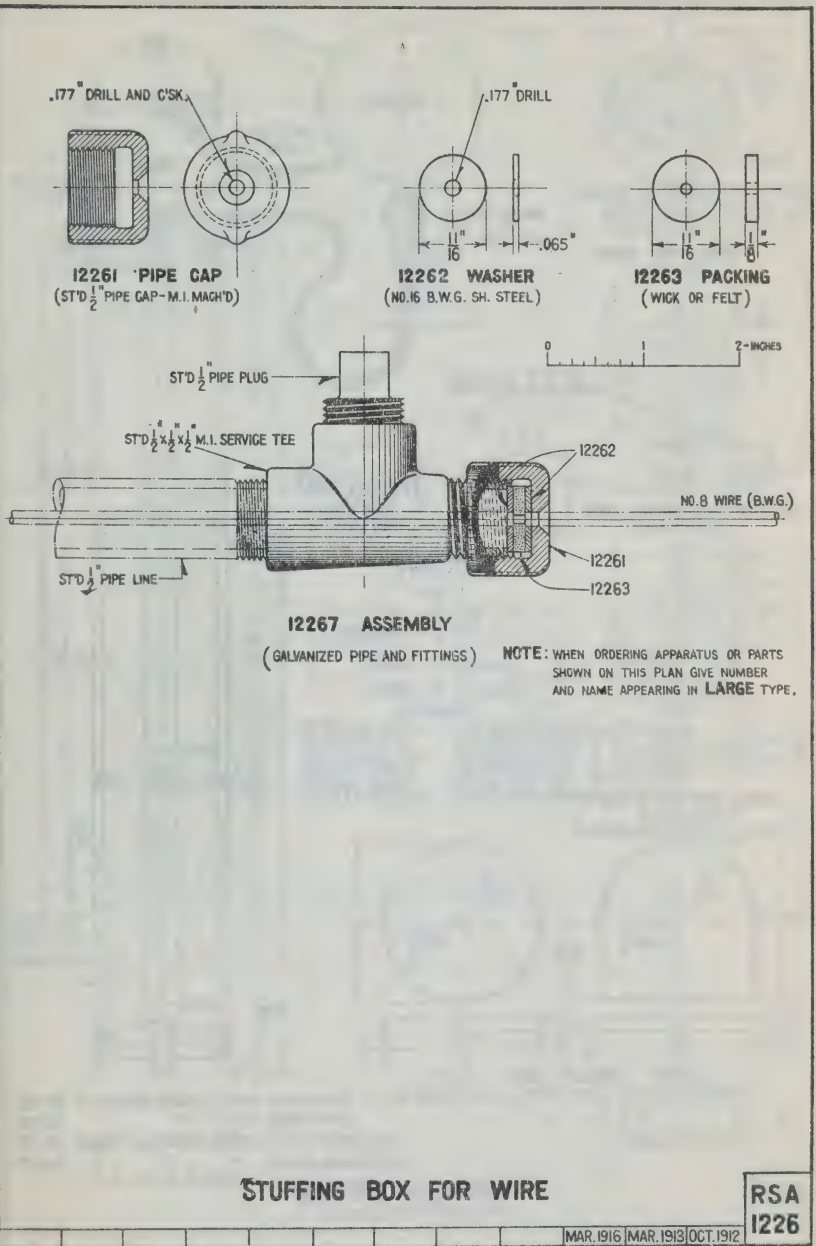
(PRIMARY-BATTERY STORAGE BATTERY)

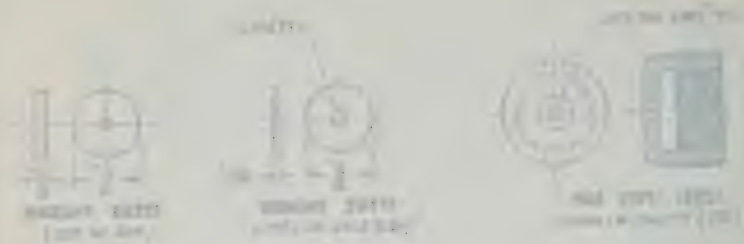
WATER-LEVEL MEASUREMENT INSTRUMENT





# Railway Signal Association.





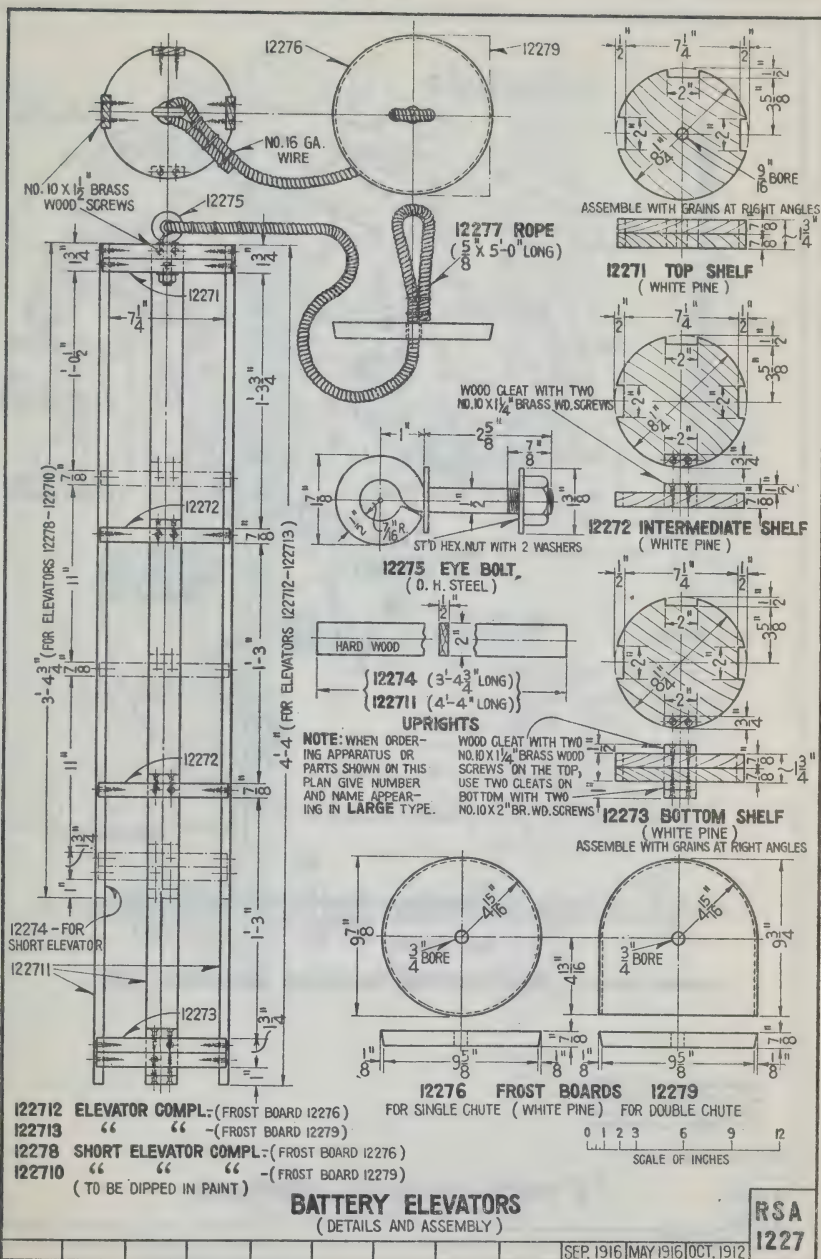
10087 ASSEMBLY

(GALVANIZED PIPE AND FITTINGS) NOTE: WHEN ORDERING REPAIRS OR PARTS, SHOW ON THIS PLAN AND NUMBER TWO HOLE LOCATIONS IN PLATE CLAMP

STUFFING BOX FOR WIRE

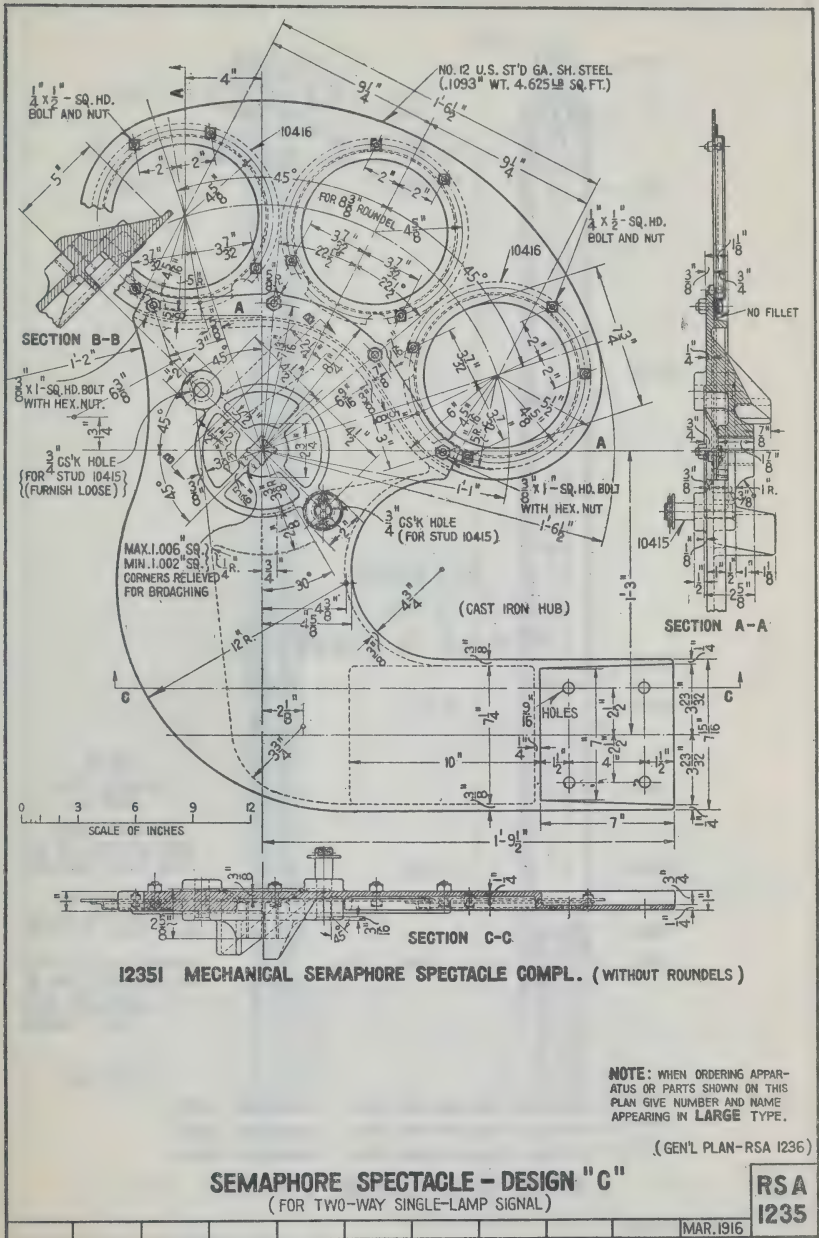


# Railway Signal Association.





# Railway Signal Association.



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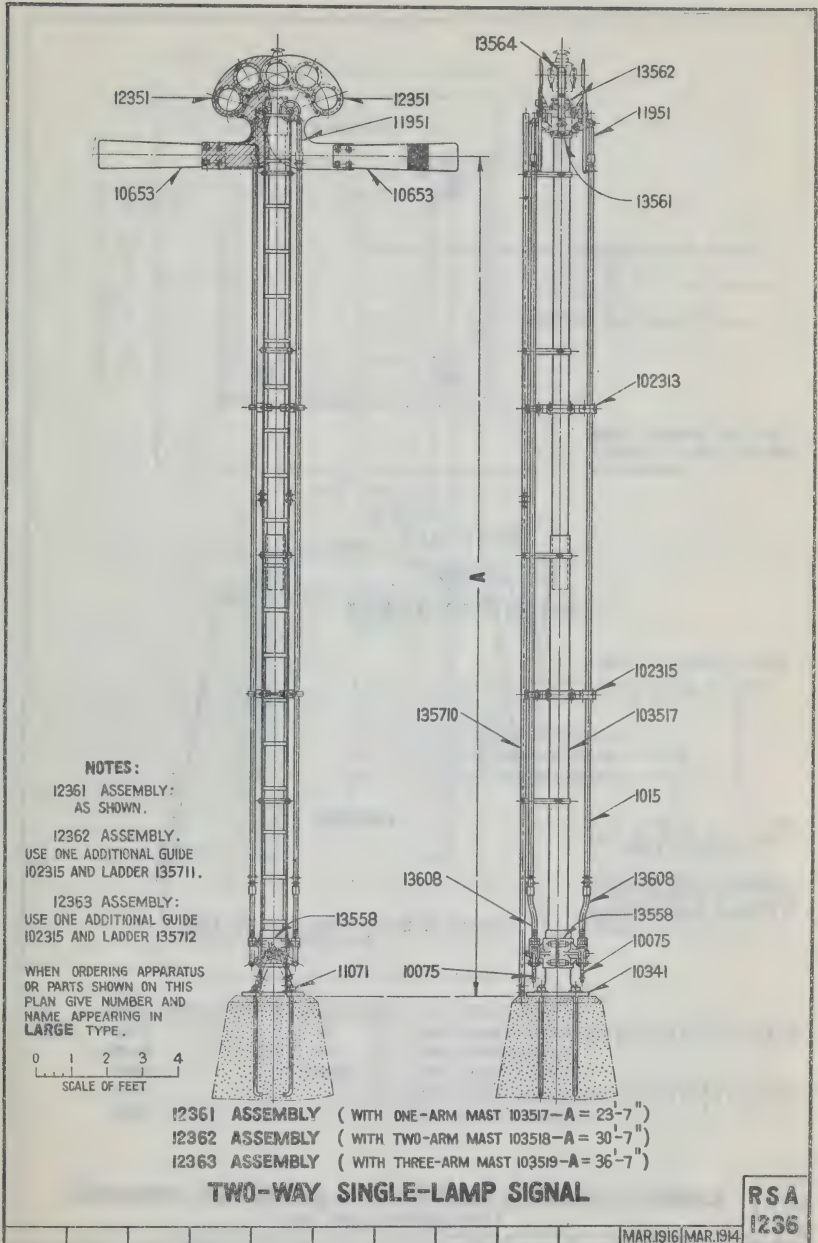
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CHICAGO, ILLINOIS

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CHICAGO, ILLINOIS



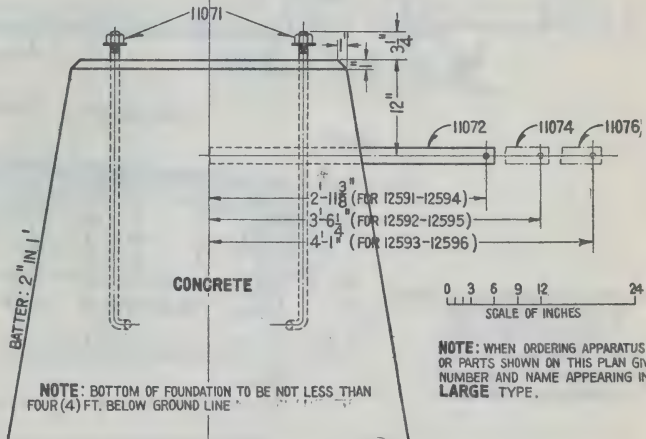
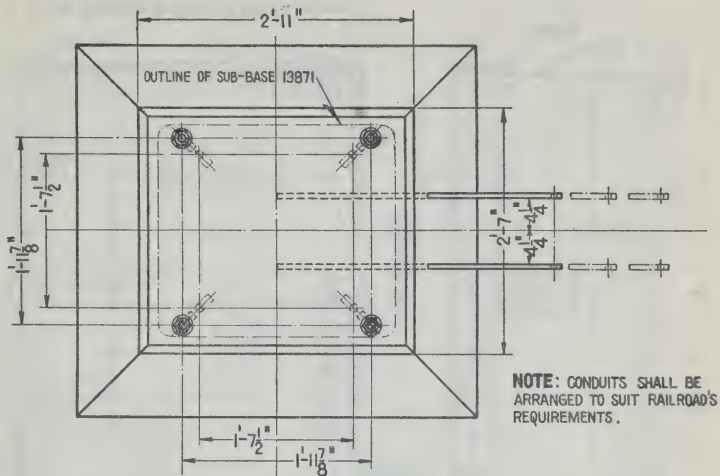
# Railway Signal Association.







# *Railway Signal Association.*

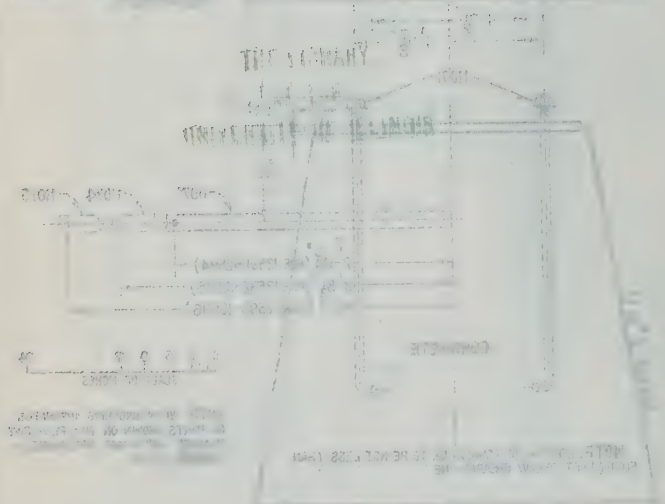


12591	ASSEMBLY	FOR	DOUBLE	CASE	(FOR 1-ARM LADDER)	} BOLTS SPACED 1'-7 1/8" X 1'-7 1/8" CTRS.
12592	"	"	"	"	(FOR 2-ARM LADDER)	
12593	"	"	"	"	(FOR 3-ARM LADDER)	
12594	"	"	SINGLE	"	(FOR 1-ARM LADDER)	} BOLTS SPACED 1'-7 1/2" X 1'-7 1/2" CTRS.
12595	"	"	"	"	(FOR 2-ARM LADDER)	
12596	"	"	"	"	(FOR 3-ARM LADDER)	

**FOUNDATION FOR GROUND MAST BOTTOM MECHANISM SIGNALS**  
(FOR SINGLE OR DOUBLE CASE)

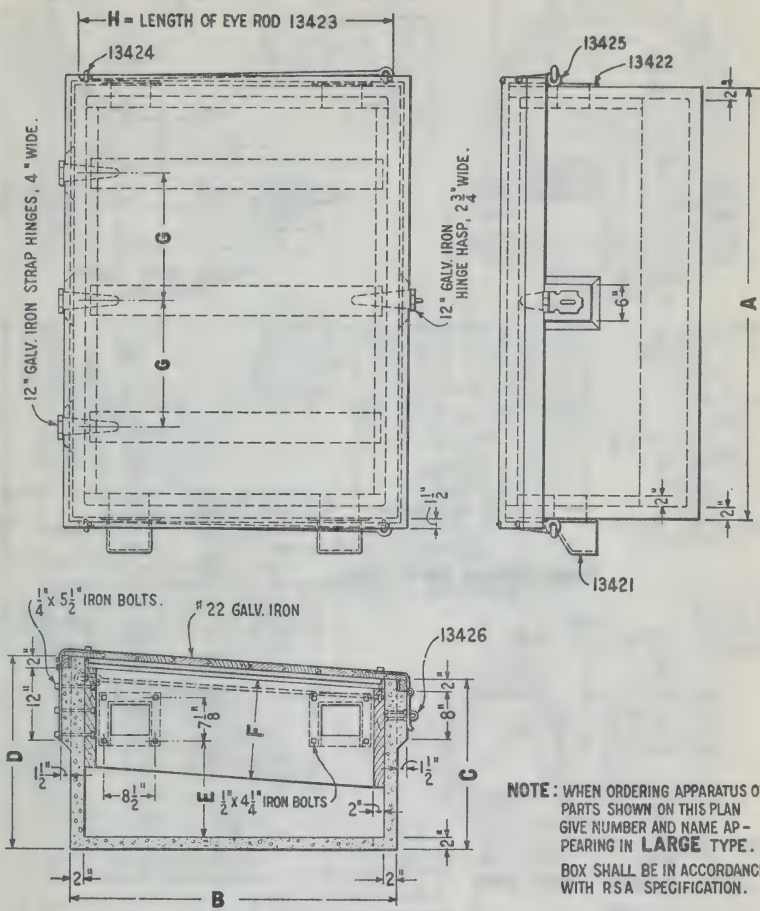
**RSA**  
**1259**

MAY 1916



NO.	DESCRIPTION	QTY.	UNIT PRICE	TOTAL
1	FOR SIGNAL POST	1	10.00	10.00
2	FOR SIGNAL ARM	1	5.00	5.00
3	FOR SIGNAL HEAD	1	15.00	15.00
4	FOR SIGNAL POST	1	10.00	10.00
5	FOR SIGNAL ARM	1	5.00	5.00
6	FOR SIGNAL HEAD	1	15.00	15.00
7	FOR SIGNAL POST	1	10.00	10.00
8	FOR SIGNAL ARM	1	5.00	5.00
9	FOR SIGNAL HEAD	1	15.00	15.00
10	FOR SIGNAL POST	1	10.00	10.00

Railway Signal Association.

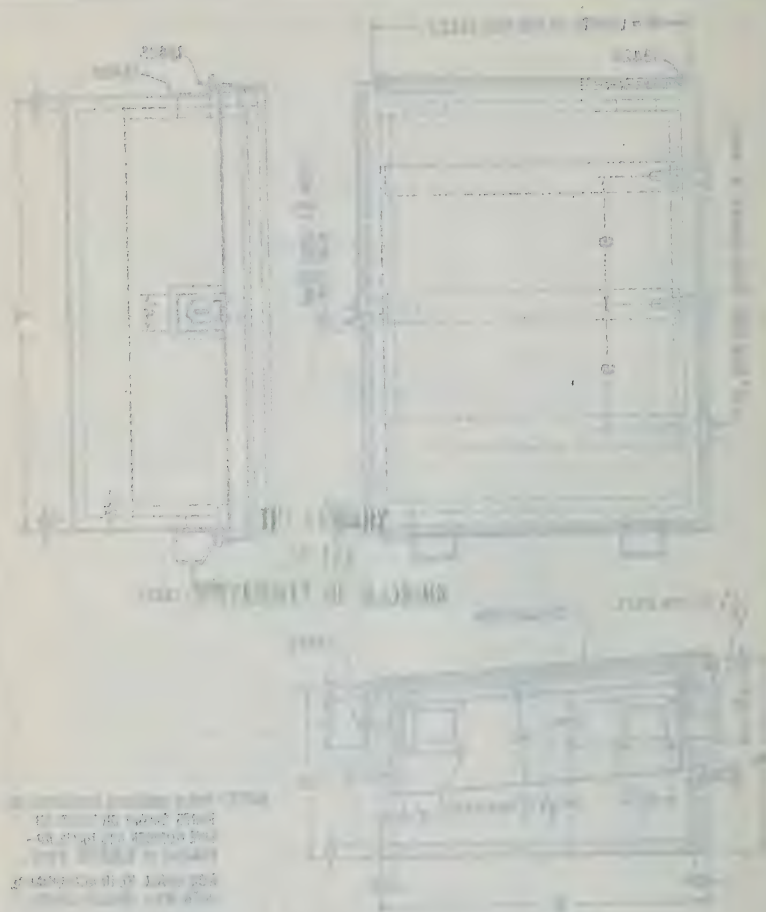


ASSEMBLY	A	B	C	D	E	F	G	H
13431	6'-0"	4'-6"	2'-4"	2'-8"	1'-6"	1'-4"	1'-9"	4'-3"
13432	4'-4"	3'-3"	2'-0"	2'-4 3/8"	1'-2 5/8"	1'-0"	1'-6"	3'-0"

CONCRETE STORAGE BATTERY BOX

RSA  
1343

SEPT.1916 MAR.1914



1. The building is a two-story structure.  
2. The building is located in the city of New York.  
3. The building is owned by the City of New York.  
4. The building is used for the purpose of housing the City of New York.

1	2	3	4	5	6	7	8	9	10
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

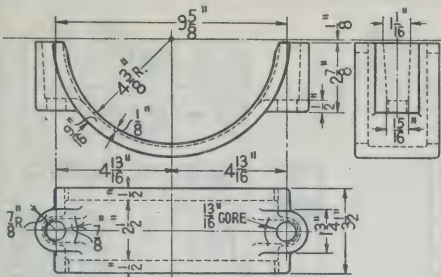
RESEARCH REPORT NO. 100

100

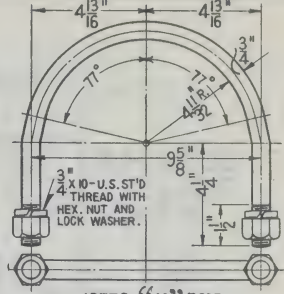
100



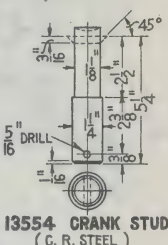
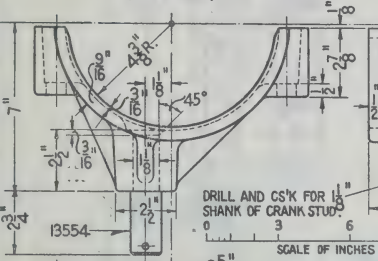
# Railway Signal Association.



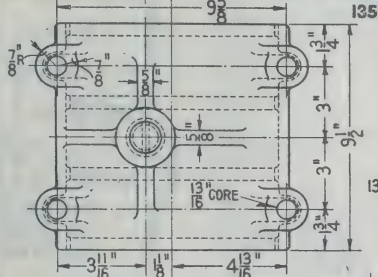
**13551 BACK CLAMP**  
(CAST IRON)



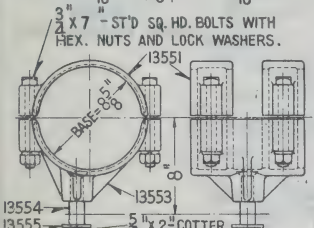
**13552 "U" BOLT**  
(O. H. STEEL)



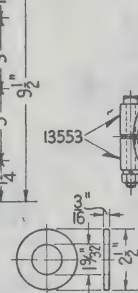
**13554 CRANK STUD**  
(C. R. STEEL)



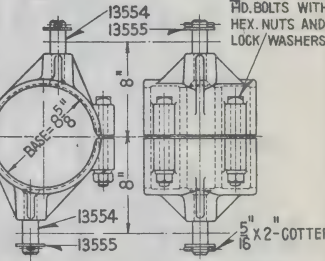
**13553 CRANK BEARING CLAMP**  
(CAST IRON)



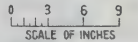
**13555 SINGLE BEARING COMPL.**  
(WITH BACK CLAMPS)  
(GEN'L PLAN - RSA 1236)



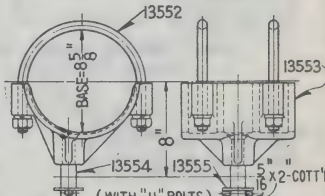
**13553 CRANK BEARING CLAMP**  
(CAST IRON)



**13558 DOUBLE BEARING COMPL.**



**13555 WASHER**  
(IRON)



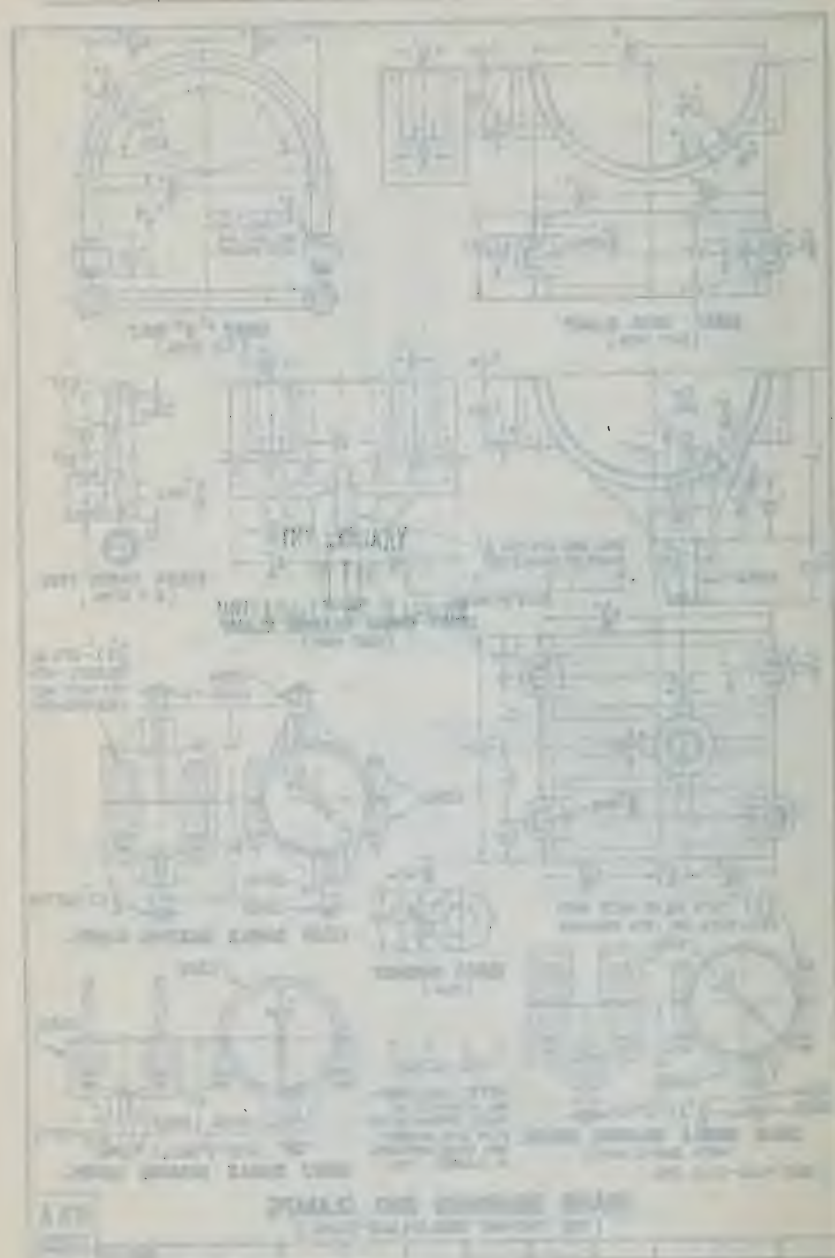
**13557 SINGLE BEARING COMPL.**  
(WITH "U" BOLTS)

**NOTE:** WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN LARGE TYPE.

## CRANK BEARINGS AND CLAMPS (FOR TWO-WAY SINGLE-LAMP SIGNAL)

**RSA 1355**

MAR. 1916

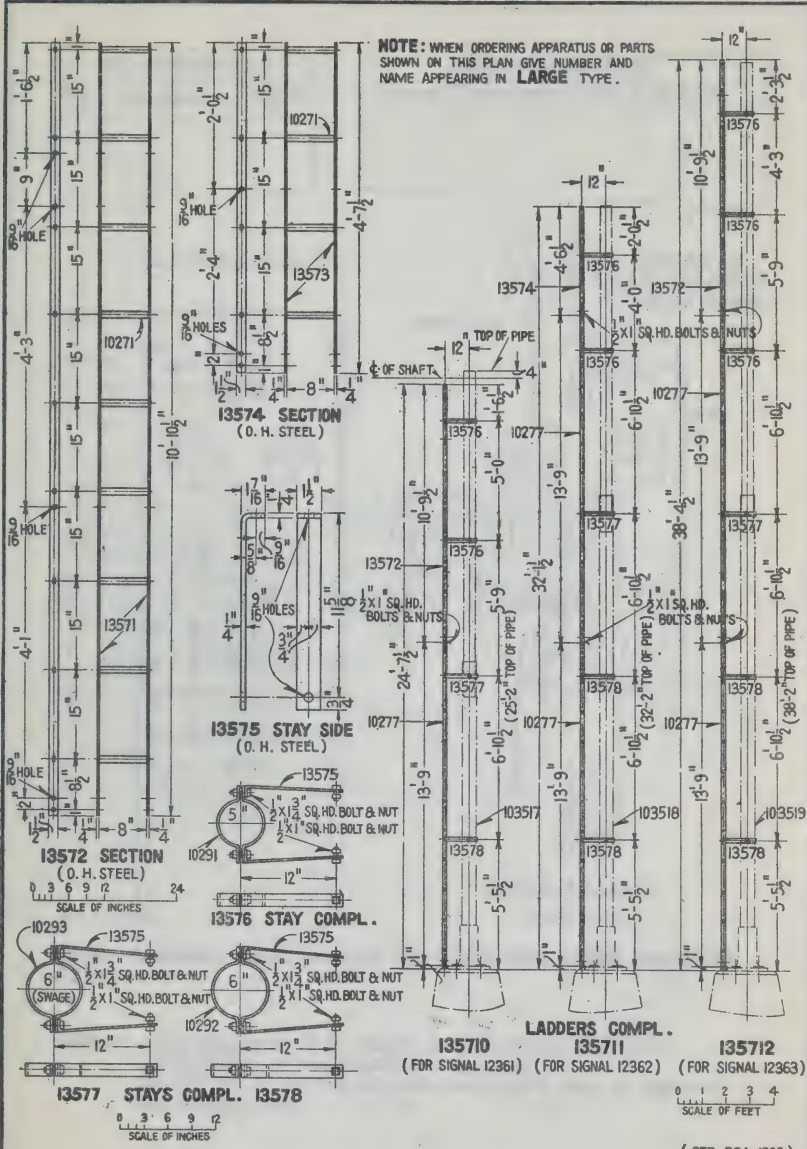








Railway Signal Association.

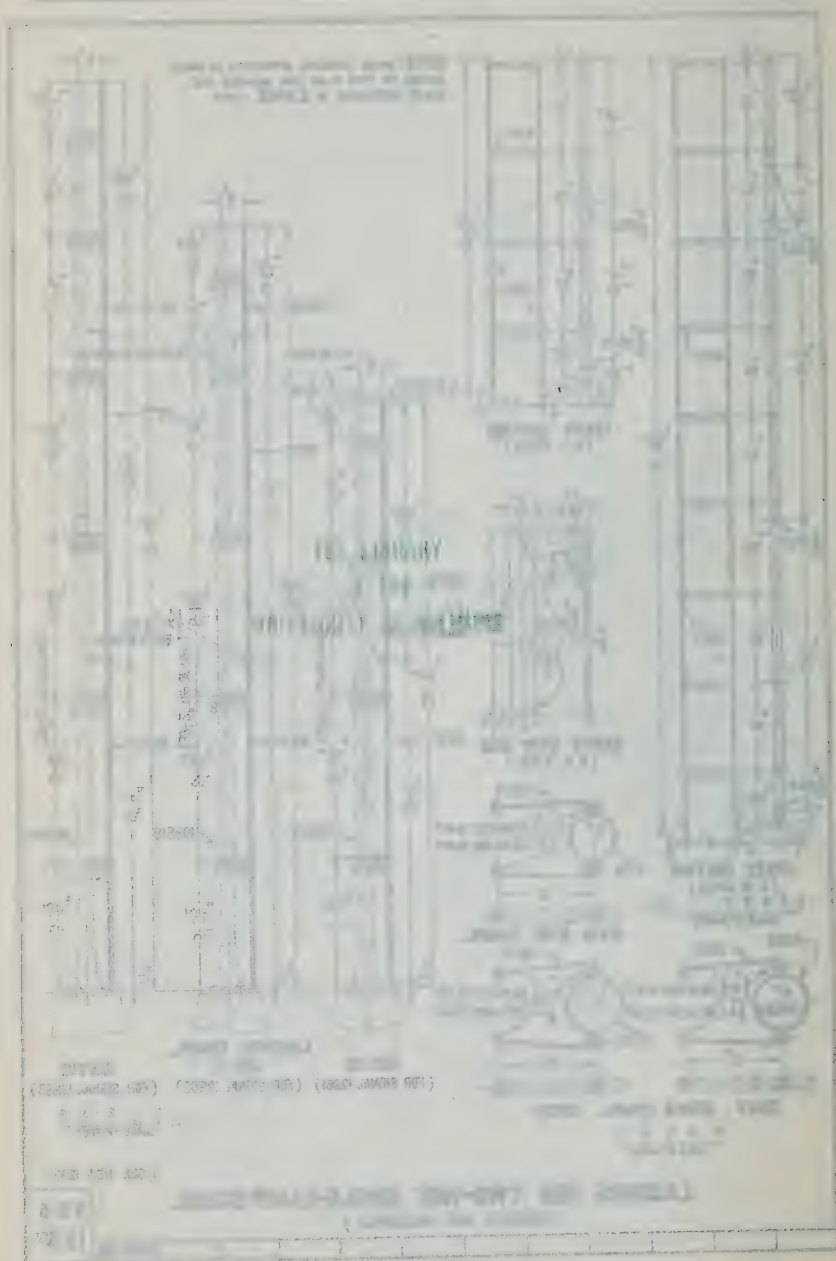


LADDERS FOR TWO-WAY SINGLE-LAMP SIGNAL  
(DETAILS AND ASSEMBLY)

RSA  
1357

MAR. 1916





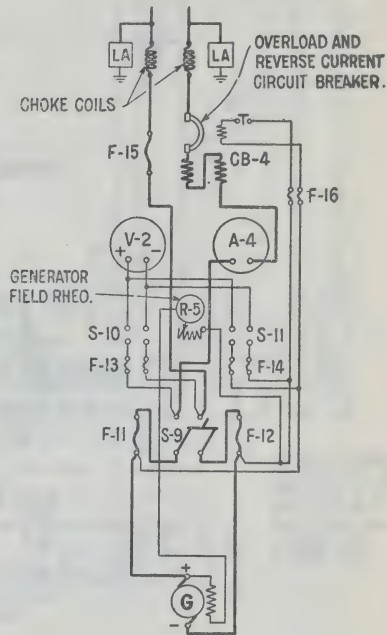
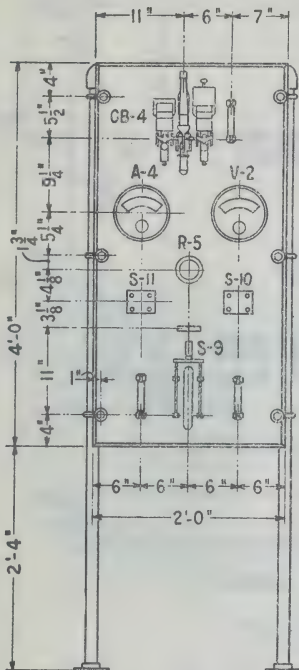
# Railway Signal Association.

## BILL OF MATERIAL

REQ. NO.	DESCRIPTION	DESIGN. NO.

## MANIPULATION CHART

FUNCTION	MANIPULATION IN ORDER OF PROCEDURE



WIRING DIAGRAM  
(BACK VIEW.)

13791 CHARGING PANEL WITHOUT LIGHTNING PROTECTIVE APPARATUS.  
13792 " " WITH " " " "

NOTES: PANEL SHALL BE OF 1/2" OIL FINISHED BLACK SLATE WITH 3/8" x 3/8" BEVEL.  
SUPPORTS SHALL BE IN ACCORDANCE WITH RSA 1243.  
COMPLETE BILL OF MATERIAL AND MANIPULATION CHART SHALL BE FURNISHED WITH CHARGING PANEL.

GENERATOR CHARGING PANEL  
(600 VOLTS OR LESS.)

RSA  
1379

SEPT. 1916

RESEARCH REPORT NO. 100	

RESEARCH REPORT NO. 100	

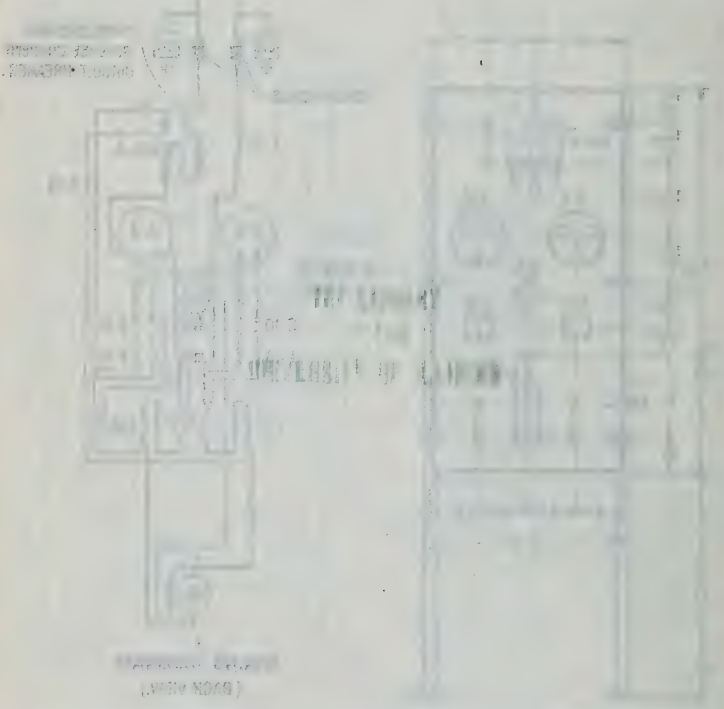


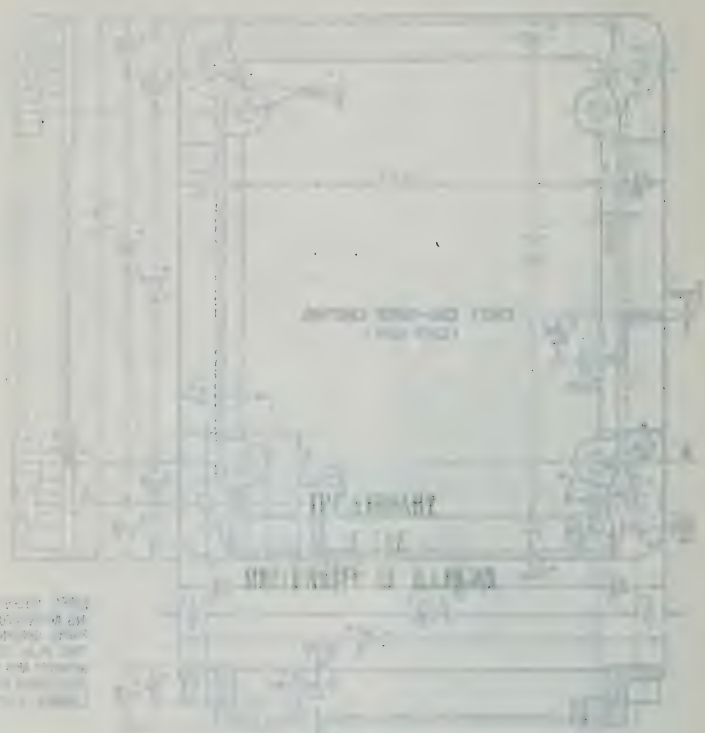
FIGURE 1. Schematic diagram of the laboratory control panel.

The control panel is designed to operate the laboratory equipment. It consists of a central vertical column of components, including a large circular gauge at the top, several smaller gauges and switches in the middle, and a large rectangular control unit at the bottom. To the left of this central column is a complex arrangement of pipes, valves, and smaller gauges, possibly representing a fluid or gas handling system. To the right is a large rectangular panel with a grid of smaller circular indicators or gauges. Various lines and labels connect these components, indicating their functional relationships.

# RESEARCH REPORT NO. 100

100

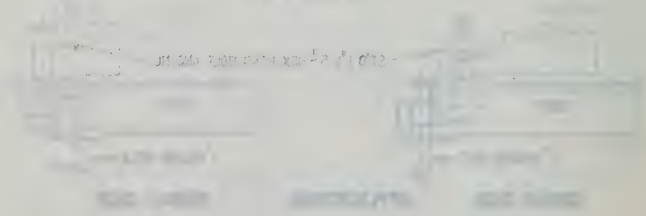




1. OFFICE  
2. RECEPTION  
3. STORAGE  
4. HALL  
5. ENTRANCE

Scale 1:100

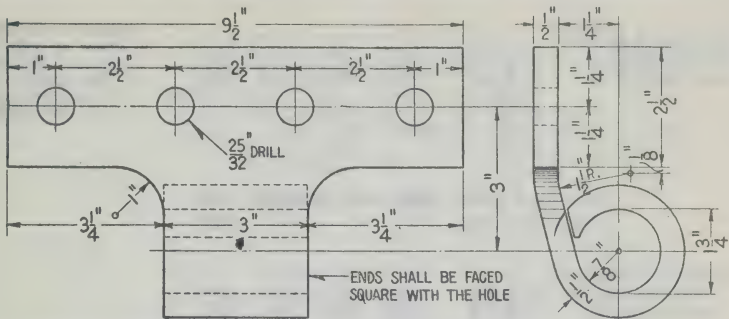
0 1 2 3 4



Architectural Drawing

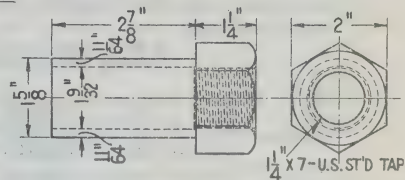
1. OFFICE  
2. RECEPTION  
3. STORAGE  
4. HALL  
5. ENTRANCE



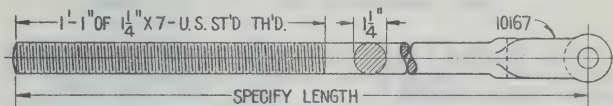
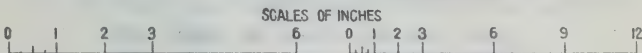


**13901 ADJ'T BRACKET**  
(O. H. STEEL)

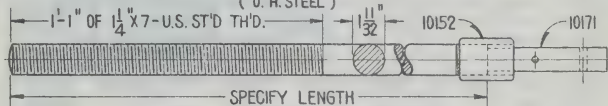
NOTE: WHEN ORDERING APPARATUS  
OR PARTS SHOWN ON THIS PLAN  
GIVE NUMBER AND NAME APPEAR-  
ING IN LARGE TYPE.



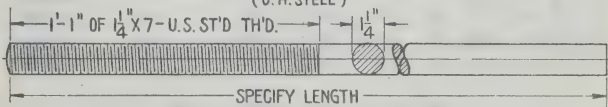
**13902 SLEEVE**  
(MALLEABLE IRON)



SPECIFY LENGTH  
**13903 THROW ROD - JAW END**  
(O. H. STEEL)



SPECIFY LENGTH  
**13904 THROW ROD - TANG END**  
(O. H. STEEL)



SPECIFY LENGTH  
**13905 THROW ROD - PLAIN END**  
(O. H. STEEL)

(SEE RSA 1391 AND 1392)

**SWITCH ADJUSTMENT DETAILS**

**RSA**  
**1390**

SEP. 1916 | MAY 1915

[illegible]

SEP. 1916	MAY 1915
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10551  
10552

ST'D  $\frac{3}{4}$ " SQ. HD. BOLT AND NUT  
 { 3" LONG FOR 13921 }  
 {  $3\frac{1}{4}$ " LONG FOR 13922 }

10553 FOR 13921  
10554 FOR 13922

10901

**13921 BRACKET COMPL.** (FOR  $\frac{3}{4}$ " SWITCH BAR - WITH BUSHING 10553)  
**13922** " " (FOR 1" SWITCH BAR - WITH BUSHING 10554)

10552  
10551

ST'D  $\frac{3}{4}$ " SQ. HD. BOLT AND NUT:  
 { 3" LONG FOR 13923 }  
 {  $3\frac{1}{4}$ " LONG FOR 13924 }

10553 FOR 13923  
10554 FOR 13924

10902  
10901

3- $\frac{1}{4}$ " X 7- U.S.  
ST'D HEX. NUTS

**13923 BRACKET COMPL. WITH SLEEVE AND NUTS** (FOR  $\frac{3}{4}$ " SWITCH BAR)  
**13924** " " " " " " (FOR 1" SWITCH BAR)

**NOTE:** BRACKET COMPLETE WITH SLEEVE AND NUTS TO BE SECURELY ATTACHED BEFORE SHIPMENT.

OUTLINE OF SWITCH BAR

$\frac{1}{2}$ " SPACE

**NOTE:** WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN LARGE TYPE.

13921  
13915

**13925 ADJUSTMENT COMPL.** (WITH THROW ROD 13915 AND BRACKET 13921 FOR  $\frac{3}{4}$ " BAR)  
**13926** " " " " " " " " " " 13922 "  $\frac{1}{4}$ " " "  
**13927** " " " " " " " " " " 13921 "  $\frac{3}{8}$ " " "  
**13928** " " " " " " " " " " 13922 "  $1\frac{1}{8}$ " " "  
**13929** " " " " " " " " " " 13921 "  $1\frac{3}{4}$ " " "  
**139210** " " " " " " " " " " 13922 "  $1\frac{1}{2}$ " " "

0 3 6 9 12  
SCALE OF INCHES

(SEE RSA 1055-1390 AND 1391)

**SWITCH ADJUSTMENT-INSULATED**  
(ASSEMBLY)

**RSA**  
**1392**

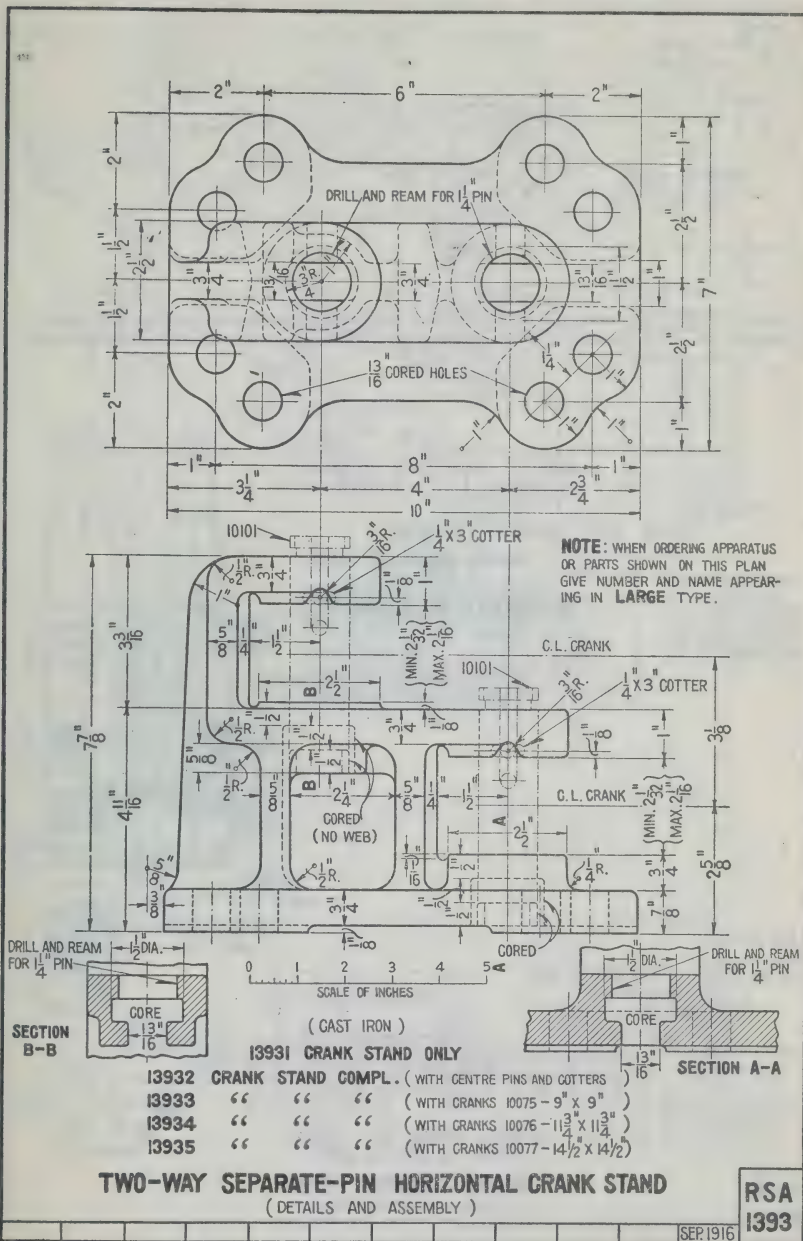
SEP. 1916

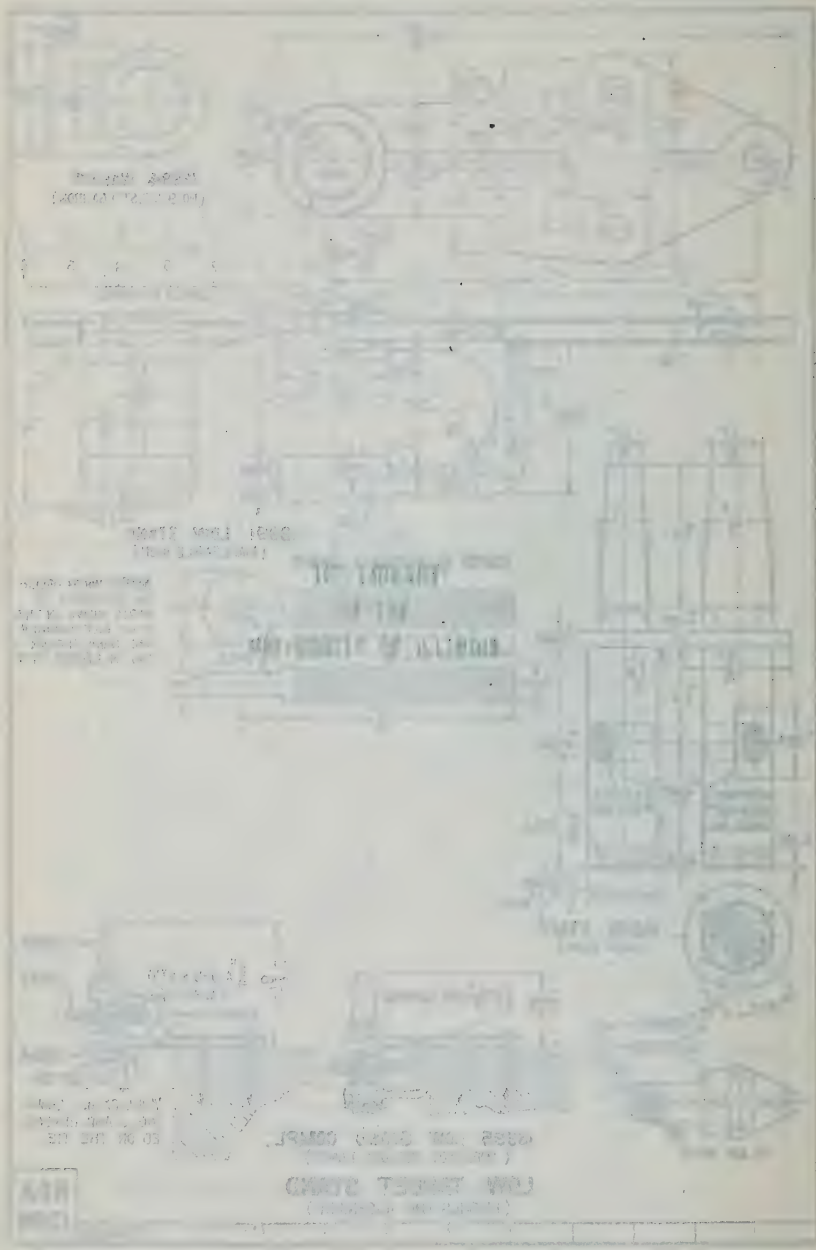
**RSA**  
**1392**

SEP 19 1966









Architectural Drawing  
(Scale: 1/4" = 1'-0")

Architectural Drawing  
(Scale: 1/4" = 1'-0")

Architectural Drawing  
(Scale: 1/4" = 1'-0")

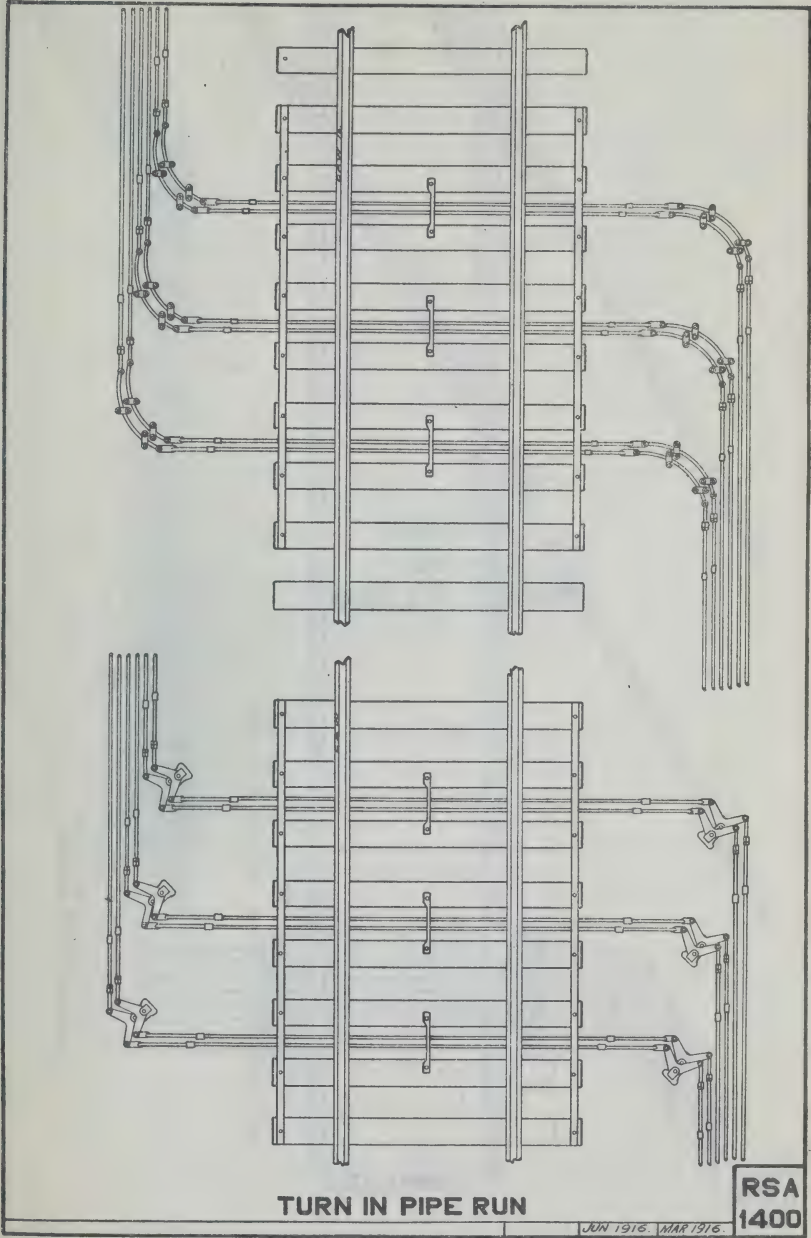
Architectural Drawing  
(Scale: 1/4" = 1'-0")

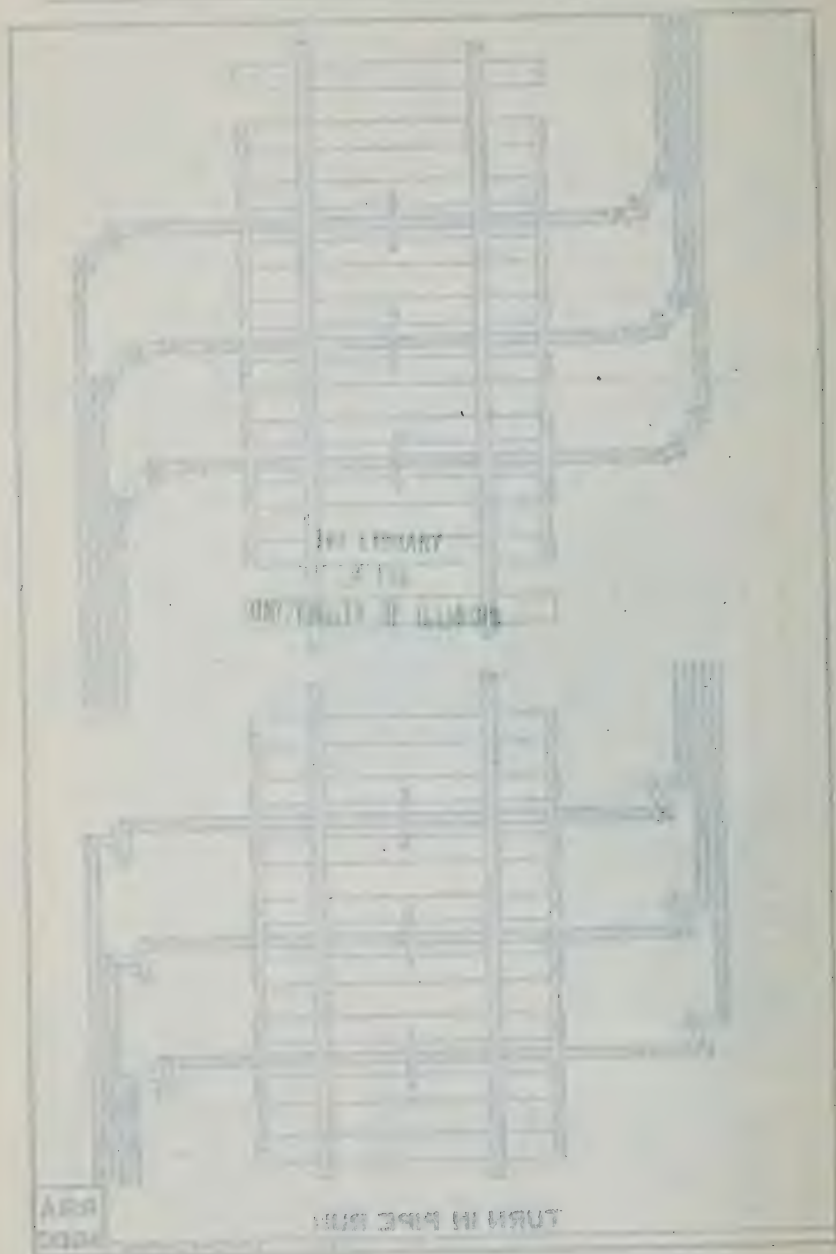
Architectural Drawing  
(Scale: 1/4" = 1'-0")

Architectural Drawing  
(Scale: 1/4" = 1'-0")

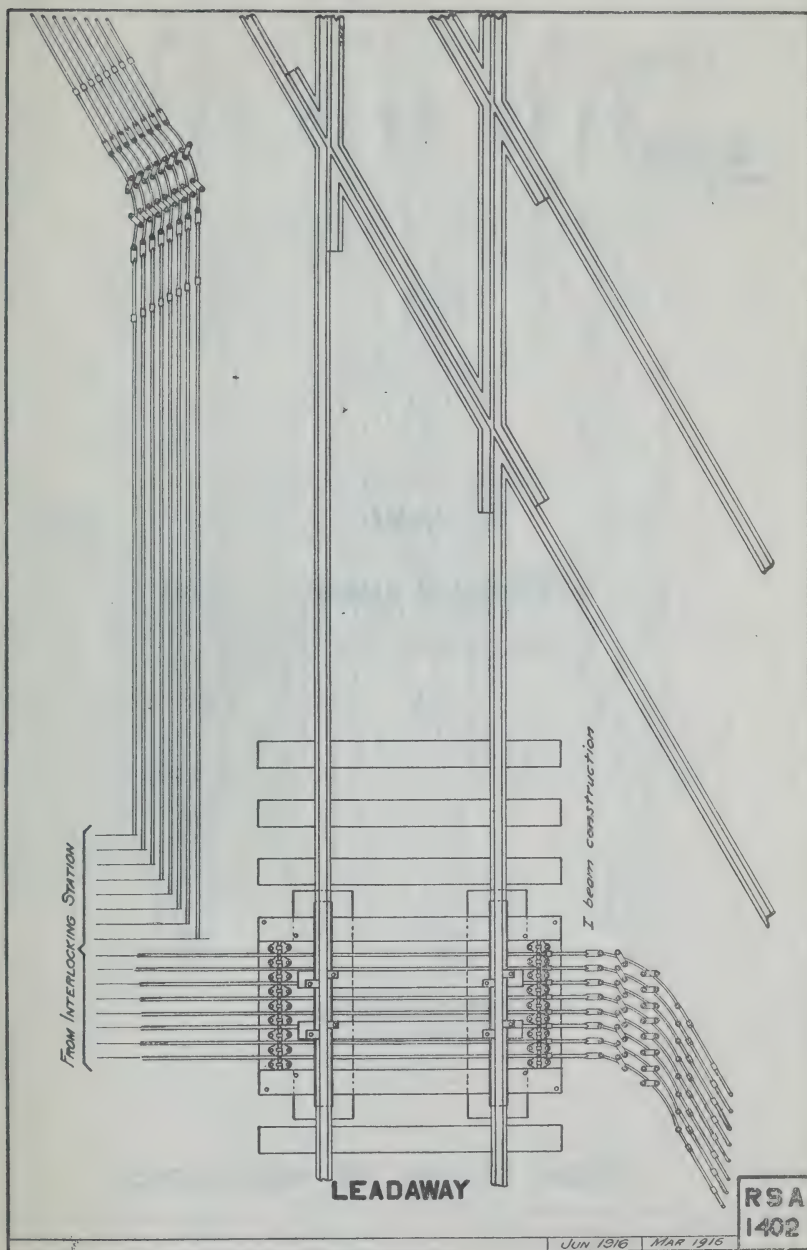
Architectural Drawing  
(Scale: 1/4" = 1'-0")

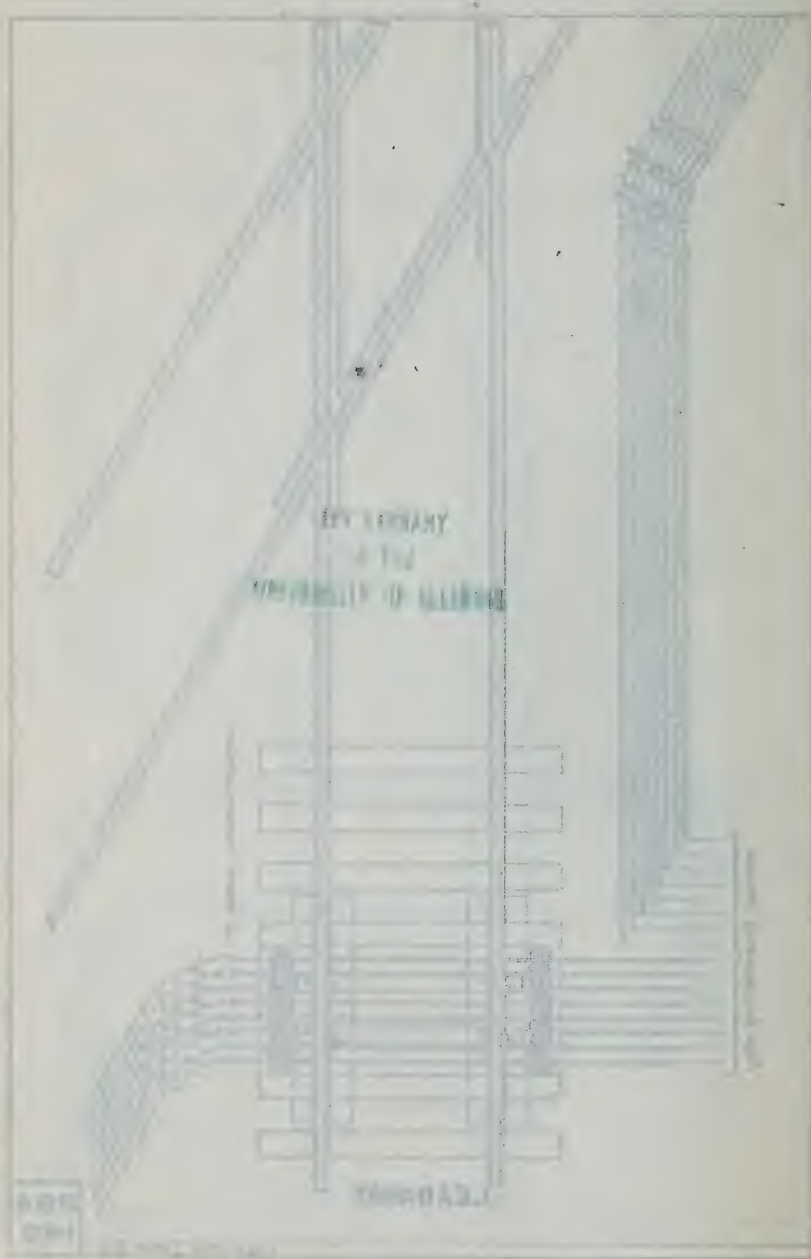
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(Scale: 1/4" = 1'-0")

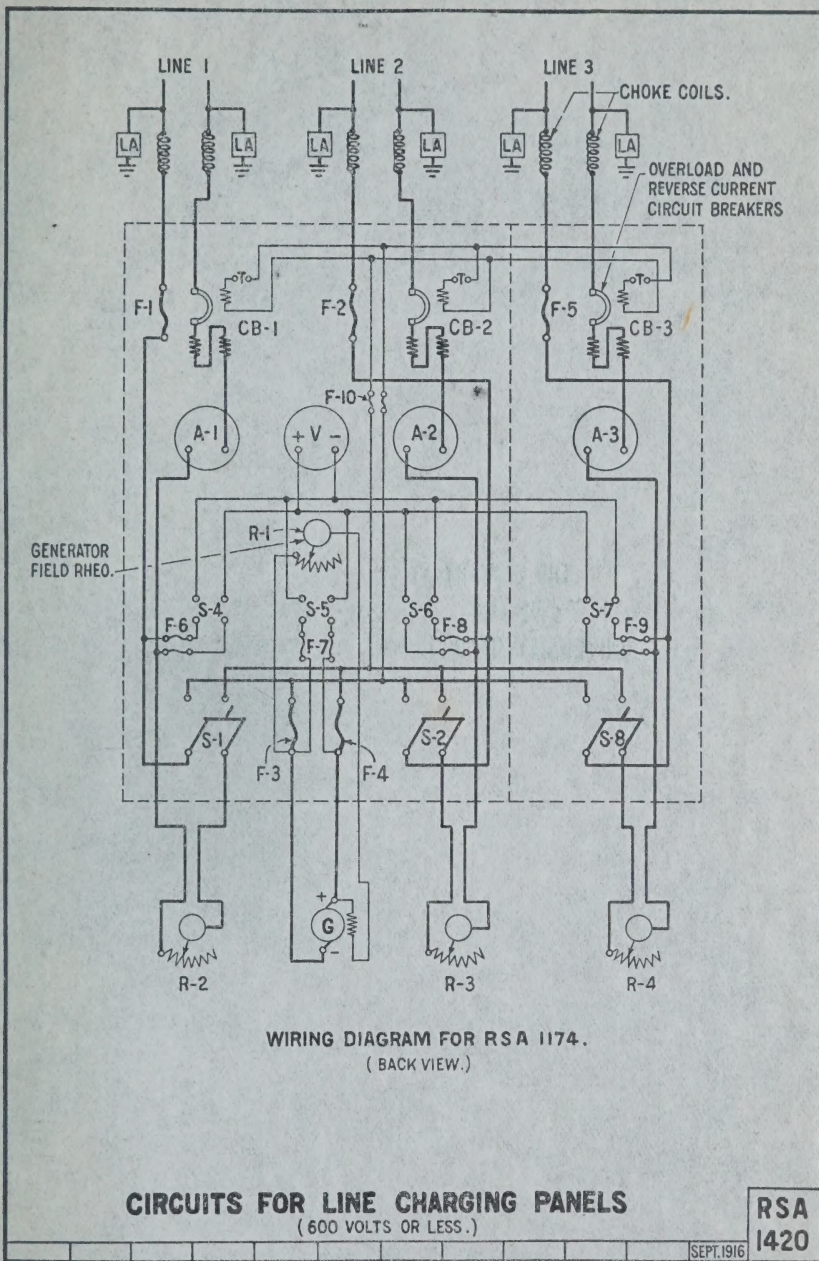




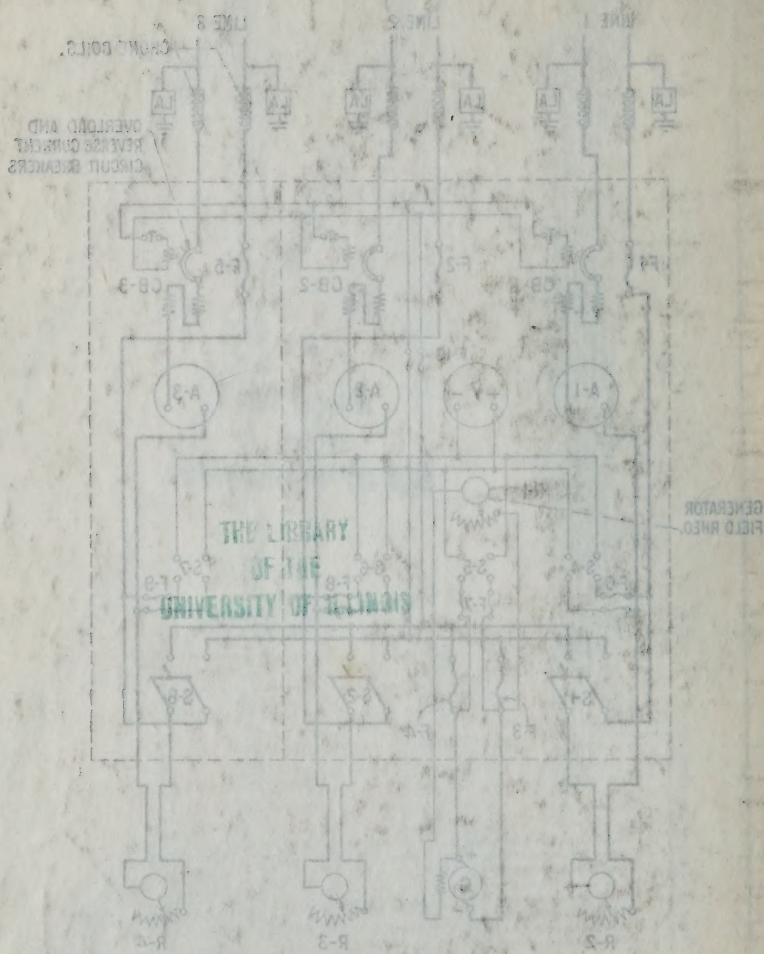




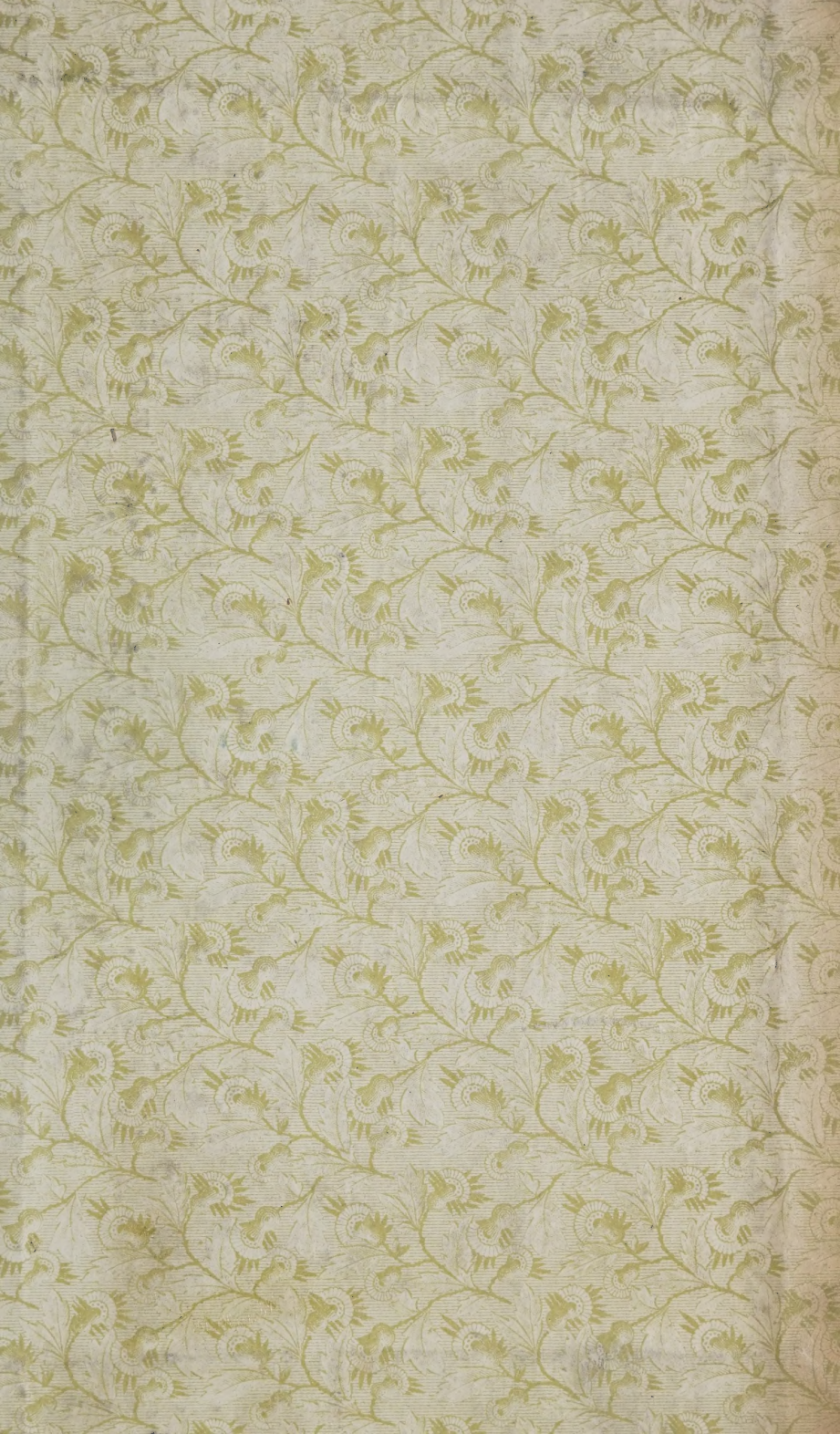








CIRCUITS FOR LINE CHARGING PANELS  
(800 VOLTS OR LESS)  
WIRING DIAGRAM FOR R2A LINE  
(BACK VIEW)





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